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SAVANNAH HARBOR, GA.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF SAVANNAH HARBOR, GA.

December 7, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

War Department,
Washington, December 4, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated September 25, 1916, together with copies of reports from Col. W. C. Langfitt, Corps of Engineers, dated August 19, 1915, and June 27, 1916, with maps, on preliminary examination and survey, respectively, of Savannah Harbor, Ga., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washingon, September 25, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Savannah Harbor, Ga.

1. There are submitted herewith for transmission to Congress reports dated August 19, 1915, and June 27, 1916, with maps, by Col.

W. C. Langfitt, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act approved March 4, 1915, of Savannah Harbor, Ga.

2. Savannah Harbor comprises the lower 20 miles of Savannah River, Tybee Knoll, Tybee Roads, and Tybee Bar. The present project, adopted by the river and harbor acts of March 2, 1907, June 25, 1910, and July 25, 1912, provides for a channel 26 feet deep at mean low water from the sea to the western limits of Savannah, a distance of 28 miles, with widths varying from 400 to 600 feet, and a channel thence 2 miles to the foot of Kings Island 21 feet deep at mean low water and 300 feet wide. The mean tidal range is 6.2 feet at the city and 6.5 feet on the bar. The amount expended on this project to June 30, 1915, was $2,762,959.25, of which $1,796,867.06 was for improvement and $966,092.19 for maintenance. The total expenditures of Government funds under all projects to June 30, 1915, amounted to $10,322,737.49.

3. The commerce of the harbor has steadily increased and now amounts to about 3,000,000 tons a year, valued at about $350,000,000. Local interests are desirous of securing greater depth and width to meet the needs of ocean-going vessels, which are being constructed with increased size and draft. They also desire that the channel at West Broad Street be widened in lieu of the turning basin recommended in House Document No. 290, Sixty-third Congress, first session, and that mooring dolphins be provided at Five Fathom Hole, near Fort Oglethorpe, with some widening and deepening of the channel at that place. The district officer proposes to retain the present project depth of 26 feet at mean low water from the Seaboard Air Line Railway bridge at Savannah to Quarantine, giving this section a general width of 400 feet, and to increase the project depth to 30 feet from Quarantine to the sea, with a general width of 500 feet. He also considers advisable the repair of existing training walls and repair and extension of the jetties, the closing of the south channel, with a dredged cut between the river and Habersham Creek as an alternative, the widening of the channel at West Broad and Barnard Streets to 600 feet, and the widening of the channel opposite Fort Oglethorpe to 900 feet, with a provision of mooring dolphins, all at an estimated cost of $1,920,000, including maintenance during construction and $250,000 for an additional dredge, which is considered necessary for the prompt completion of the work and for its subsequent maintenance. The district officer, who is also the division engineer, expresses the opinion that the locality is worthy of further improvement to the extent indicated, provided that the widening at West Broad and Barnard Streets be contingent upon local interests furnishing free of cost any right of way found necessary, together with a convenient place for deposit of spoils.

4. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 25, 1916, concurring in the views of the district officer.

5. After due consideration of the above-mentioned reports, I concur in the views of the district officer and the Board of Engineers for

Rivers and Harbors, and therefore report that the further improvement by the United States of Savannah Harbor, Ga., is deemed advisable to the extent proposed by the district officer, as described above, at a total estimated cost of $1,920,000, including maintenance during construction, and $350,000 per annum for maintenance of the entire project after completion; provided that the proposed widening at West Broad and Barnard Streets be contingent upon local interests furnishing free of cost any right of way found necessary, together with a convenient place for deposit of spoils. The first appropriation should be $725,000, and subsequent appropriations should be made so as to complete the work in four years.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Second indorsement.]

The Board of Engineers for Rivers and Harbors,
July 25, 1916.

To the Chief of Engineers, United States Army:

1. The following is in review of the district officer's reports authorized by the river and harbor act of March 4, 1915, on preliminary examination and survey of Savannah Harbor, Ga.

2. This harbor is 112 miles by water south of Charleston Harbor, S. C., and 111 miles by water north of Brunswick Harbor, Ga., and comprises the lower 20 miles of Savannah River, Tybee Knoll, Tybee Roads, and Tybee Bar.

3. The present project, adopted by the river and harbor acts of March 2, 1907, June 25, 1910, and July 25, 1912, provides for a channel 26 feet deep at mean low water from the sea to the western limits of Savannah, a distance of 28 miles, with widths varying from 400 to 600 feet, and a channel thence 2 miles to the foot of Kings Island, 21 feet deep at mean low water and 300 feet wide. The mean tidal range is 6.2 feet at the city and 6.5 feet on the bar. At the end of the fiscal year 1915 the 26-foot channel was 86 per cent completed and the 21-foot channel 50 per cent. The expenditures on the 26-foot channel to June 30, 1915, were $1,715,830.42 for improvement and $966,092.19 for maintenance. The amount expended on all projects to June 30, 1915, was $10,322,737.49.

4. The commerce of this port has been on the whole increasing, especially in value, as better facilities have been provided through Federal expenditures, and now normally amounts to about 3,000,000 tons, having a value of about $350,000,000. The size and draft of ocean-going vessels are increasing, and to meet these conditions local interests ask that the project depths and widths be correspondingly increased; also that the channel at West Broad Street be widened in lieu of the turning basin recommended in House Document No. 290, Sixty-third Congress, first session, and that mooring dolphins be

provided at Five Fathom Hole, near Fort Oglethorpe, together with some local widening and deepening of the channel at that place. No changes in the 21-foot project are requested.

5. The investigations and further studies of the district officer in connection with the survey were based upon the foregoing, consideration being given to such channel dimensions and additional work as seemed to him desirable. He presents a comprehensive plan of improvement. It is proposed to retain the present project depth of 26 feet at mean low water from the Seaboard Air Line Railway bridge at Savannah to Quarantine, giving this section a general width of 400 feet, and to increase the project depth from Quarantine to the sea to 30 feet, with a general width of 500 feet. It is deemed advisable to repair and extend existing training walls and jetties and to close the south channel so as to conserve the ebb flow in the north or main channel, and thereby increase the scouring effect and lessen the amount and cost of future maintenance. As south channel forms a part of the inland route from Savannah to Fernandina, its closing will necessitate a dredged cut between the river and Habersham Creek as an alternative for this part of the route. Consideration has been given to widening the channel at West Broad and Barnard Streets to 600, 700, and 800 feet. The present width is 500 feet, and the district officer believes this should be increased to 600 feet. The plan proposed also includes widening the channel opposite Fort Oglethorpe to 900 feet, with the provision of mooring dolphins.

6. It is estimated that the work involved in this project will require three and one-half to four years to complete. To carry it out and do the necessary maintenance work will require one dredge in addition to the three now available. The estimated cost of the project proposed, including the additional dredge and maintenance during construction, is $1,920,000. The estimate for subsequent annual maintenance of the entire project, including the 21-foot channel, is $350,000. The district officer is of the opinion that the locality is worthy of further improvement to this extent, provided that the widening at West Broad and Barnard Streets be contingent upon local interests furnishing free of cost any right of way found necessary, together with convenient place of spoil deposit.

7. Savannah has the largest and most valuable commerce of any South Atlantic port, and full advantage has apparently been taken of improvements already made at Federal expense. It is well known that the general size and draft of seagoing vessels have been increasing, and it seems reasonable to believe that the maximum has not yet been reached. Under present conditions some of the larger vessels have difficulty in entering and leaving, even when observing the tide, and therefore some increase in navigation facilities appears desirable. The project presented seems to meet the requirements of commerce and navigation and is well adapted to the locality. It is to be observed that of the total estimated cost ($1,920,000) $875,000 is for maintenance during construction, and that the estimated cost of the new work ($1,045,000) includes $250,000 for new plant. It is believed that this cost is reasonable when compared with the present and prospective benefits. The board therefore concurs with the district officer, who is also the division engineer, and recommends the

modification of the existing project proposed by him, at a total estimated cost of $1,920,000, of which $875,000 is for maintenance during construction and $1,045,000 for new work, including new plant, and $350,000 annually for maintenance of the entire project after completion. The first appropriation should be $725,000, and subsequent appropriations should be made so as to complete the work in four years.

8. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects so related to the project proposed that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interests of navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF SAVANNAH HARBOR, GA.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Savannah, Ga., August 19, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army.
Subject: Preliminary examination of Savannah Harbor, Ga.

1. The river and harbor act of March 4, 1915, provided for a preliminary examination of Savannah Harbor, Ga. This duty was assigned this office by letter from office of the Chief of Engineers, dated March 15, 1915, and in compliance therewith the following report is submitted.

2. The following quotations from the Annual Report for 1915 give the necessary information as to this harbor:

> *Location.*—This harbor is 112 miles, by water, south of Charleston Harbor, S. C., and 111 miles, by water, north of Brunswick Harbor, Ga., and comprises the lower 20 miles of Savannah River, Tybee Knoll, Tybee Roads, and Tybee Bar, a total distance of 28 miles. (See U. S. C. & G. S. chart No. 12.)
>
> *Original condition.*—The earliest reports, 1734, give a depth on the bar of 3 fathoms at low water, and in 1773, 13 feet could be brought to Savannah at high water During the Revolutionary War the channel was obstructed by wrecks. At the outbreak of the Civil War, 17.5 feet could be brought to the city wharves at high tide. During the war the channel was obstructed by vessels, piles, snags, torpedoes, logs, and cribs, and in 1871 the channel at low water was in places not more than 10 feet deep.
>
> *Previous projects.*—The first improvement of Savannah Harbor was authorized by act of May 18, 1826. Various improvements were authorized from time to time prior to the adoption of the present project. The total expenditures under all previous authorizations prior to the adoption of the present project was $7,260,383.98 for new work and $298,894.26 for maintenance, making a total of $7,559,278.24.
>
> *Present project.*—The present project provides for a channel 26 feet deep at mean low water from the sea to the western limits of Savannah, a distance of 28 miles, with widths varying from 400 to 600 feet, and a channel thence 2

miles to the foot of Kings Island, 21 feet deep at mean low water, and 300 feet wide. The rise and fall of tide is 6.2 feet at the city and 6.5 feet on the bar.

The 26-foot project was tentatively adopted by the river and harbor act of March 2, 1907, and definitely by the act of June 25, 1910, in accordance with a report printed in House Document No. 181, Fifty-ninth Congress, first session, at an estimated cost of $2,705,699.48. No estimate of the cost of maintenance was submitted. The revised estimate for completion of the work adopted in 1910 to complete the project was $1,545,000, with $250,000 annually for maintenance.

The 21-foot project was adopted by the river and harbor act of July 25, 1912, in accordance with a report printed in House Document No. 563, Sixty-second Congress, second session, at an estimated cost of $140,000, the cost of maintenance being included in the estimate for maintenance of the 26-foot channel.

The river and harbor act of March 4, 1913, called for an examination and report, with a view of providing a turning basin for Savannah Harbor. This report is found printed in House Document No. 290, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The 26-foot channel was 86 per cent completed at the end of the fiscal year, and the 21-foot channel 50 per cent. No dredging has been done on the latter portion of the harbor since October 2, 1913.

The controlling depth at low water is 23 feet, and is found at two localities. The channel has been straightened at the mouth of the river and materially widened over the exposed area outside of the river proper.

The expenditures on the 26-foot channel up to June 30, 1915, were $1,715,830.42 for improvement and $966,092.19 for maintenance; and on the 21-foot channel $81,036.64 for improvement—a total of $1,796,867.06 for improvement and $966,092.19 for maintenance.

3. The following congressional documents contain reports on previous examinations and surveys:

Senate Document No. 1, Thirty-third Congress, first session (Annual Report Chief of Engineers, 1853, p. 468).

House Document No. 57, Fiftieth Congress, first session. This report recommended a channel 28 feet deep at high water, at an estimated cost of $6,660,000. Contains maps.

House Document No. 115, Fifty-third Congress, third session. This report recommended a channel 26 feet deep at high water, Savannah to the sea, at an estimated cost of $3,537,720. Contains maps.

House Document No. 181, Fifty-ninth Congress, first session. This report recommends tentatively a channel 26 feet deep at mean low water, at an estimated cost of $2,705,699.48. Does not contain maps.

House Document No. 563, Sixty-second Congress, second session. This report recommends an extension of project 2 miles above existing limits, with a depth of 21 feet at mean low water, at an estimated cost of $140,000. Does not contain maps.

House Document No. 290, Sixty-third Congress, first session. This report recommends construction of a turning basin opposite the city, at an estimated cost of $154,000. Does not contain maps.

4. As the clause authorizing the examination contained no indication of its object, a letter was addressed to the Hon. Charles G. Edwards, Member of Congress, requesting information on this point or reference to those possessing it, and in reply he referred to the Savannah Board of Trade as the body to whom application for further information should be made. A letter was accordingly addressed to that body, as follows:

> The recent river and harbor act, approved March 4, 1915, calls for a preliminary examination of Savannah Harbor, Ga.
>
> Hon. Charles G. Edwards, Member of Congress, advises me that this item was inserted in the river and harbor act on request of your trade body, and I should be pleased to receive information as to what line of investigation is sought by you by this request.

To this inquiry the following reply was received:

> Replying to your valued favor of April 9 with reference to item in river and harbor act, approved March 4, 1915, calling for a preliminary examination of Savannah Harbor, Ga., I respectfully submit that investigation desired is for a 30-foot channel at mean low water in Savannah Harbor or a deeper draft if found practicable.

5. It appearing, however, that a public hearing was desirable, after due public notice by circular letter and by newspaper, and in cooperation with the board of trade, a public hearing was held July 13 at 5 p m. in the rooms of the board of trade. The minutes of the meeting are attached,[1] marked "Appendix No. 1."

6. What now appears to be desired by local interests, in the more or less immediate future, is briefly as follows, as stated by the commissioners of pilotage:

> First. The channel from the Seaboard Air Line Railway bridge to Quarantine to be dredged on the present ranges to a depth of 26 feet mean low water, at least 500 feet in width at the bottom of the cut.
>
> Second. From Quarantine to sea channel to be dredged to a depth of 30 feet at mean low water, 500 to 600 feet in width, namely, on the ranges 500 feet; at the turning points in Tybee Roads (bell buoy) and on the bar (bell buoy) and at the intersection of the range lights, 600 feet. This would enable a ship 500 to 600 feet long to make these turns with comparative ease and safety even on a strong ebb tide.
>
> Third. In lieu of the proposed turning basin it is suggested that a point of land opposite West Broad Street known as Kinsey's mill be cut off by dredging the channel to a width of 1,000 feet. This would answer every purpose of a turning basin, being at a central point of the harbor, and would eliminate a short turn or bend of the river that now exists, to the great inconvenience of shipping.
>
> Fourth. The mooring dolphins at Venus Point and the Bight being obsolete, it is suggested that new dolphins be built on the north side of what is known as the Five Fathom Hole, the moorings to be placed as indicated on United States Coast and Geodetic Survey chart No. 440; that is, from a point opposite Fort Oglethorpe on the north shore eastward for a distance of at least 2,000 feet, and the channel dredged to a width of 900 to 1,000 feet. In our opinion, this would make a splendid harbor for Government ships of any size or draft, as well as being a great convenience for deep-draft merchant ships that by wind, weather, or other causes stop en route while passing in or out of the Savannah River.

7. These suggestions were formally indorsed and recommended, without argument, by the following:

(*a*) Six masters of vessels of the Merchants & Miners' Transportation Co.
(*b*) Seven of the more prominent ship brokerage firms.
(*c*) Savannah Cotton Exchange.
(*d*) Savannah Board of Trade.
(*e*) Savannah Maritime Association.
(*f*) Six masters of vessels of the Ocean Steamship Co.

8. As spokesman for the interests represented at the meeting, Capt. Frank W. Spencer, assistant master pilot, submitted, in writing, practically the same recommendations, supported by brief arguments, and further elaborated them orally at the hearing. His written brief is as follows, attention being invited to the fact that his argument as to article 1 refers to the first and second suggestions above quoted:

> In reference to article 1, it is considered that the present channel depth and width from the Seaboard Air Line Railway bridge to the United States quarantine station is ample to meet the needs of commerce, but an increased depth etc., as recommended from the quarantine station to sea is needed, due to the fact that vessels of very deep draft are handicapped in clearing the lower har-

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[1] Not printed.

bor and bar, inasmuch as the tide has to be used at its full height in the upper harbor. With an increased depth provided from the quarantine station to sea, these deep-draft vessels would be materially aided in clearing the lower harbor and bar.

Present conditions at both the inner bell buoy in Tybee Roads and at the North Breaker bell buoy on the bar serve to handicap vessels of deep draft, as the depth and width of the channel at these two points are insufficient, as many vessels have been swept onto the strand by the tidal currents in making these turns, and it becomes highly necessary to improve conditions at these turning points.

In article 2 your attention is respectfully directed to the danger attached to this point in the immediate harbor. Many vessels have met with accidents in negotiating this point, due to the narrowness of the channel and the strong current ever present; the combination of these two evils has tended to make this point one of great concern to the maritime fraternity. An increased width at this point would not only dispose of the element of danger attached thereto, but a splendid "turning point" would be established in the harbor whereby vessels of any size or draft could be handled with safety. An added argument in reference to the improvement of this point is the fact that it is equidistant between the important terminals of the harbor, which renders it accessible to such vessels as might require such a point in order to handle them with success.

In regard to article 3, I beg to stress the fact that the Savannah River does not possess a single anchorage or mooring point for its commerce beyond the loading terminals. A mooring point is of vital importance to a port of this size. The mooring dolphins which were constructed by the Government several years ago at the Bight and Venus Point have rotted away, and to-day we do not possess a single point to moor deep-draft vessels to. This is a serious matter, and the pilots are often compelled to resort to forced methods in navigating the river with these deep-draft vessels simply because there is no accommodation for them. This lack of a mooring point is again unfortunate, aside from the commercial viewpoint, as we are at present unable to moor the larger vessels of the Navy in the river.

It is considered that the point referred to (Fort Jackson) is admirably situated for mooring dolphins, and your utmost consideration in regard to this point is requested.

9. Of especial interest is the letter of Mr. W. D. Faucette, chief engineer Seaboard Air Line Railway. (See Exhibit L[1] of minutes.) In this letter Mr. Faucette calls attention: (*a*) To growth of imports and exports in value from 1895 to 1912, the increases being, respectively: Imports from $425,000 to $5,129,979, and exports from $20,523,760 to $104,286,925; (*b*) to growth of population of Savannah and Georgia, being, respectively, from 1900 to 1910, 18 per cent for the State as a whole and 19 per cent for Savannah; (*c*) to the fact that the commerce of Savannah is not local but general; (*d*) to a comparison of projects of importance of the various ports on the South Atlantic and Gulf coasts, from Baltimore, Md., to Galveston, Tex., showing that the project for Savannah Harbor is among the smaller ones; (*e*) to the faith the Seaboard Air Line Railway has shown in Savannah's future by the large expenditures—over $1,000,000—the railway company has made for terminals; (*f*) to the limitations which our shallow entrances and harbors place on the naval architects in designing ships of economical operation, and quotes from the opinion of Mr. Dobson, naval architect, and from London engineering on the same subject, both agreeing that economical ships must be deep draft; (*g*) to draft of vessels entering and leaving Savannah in 1913, 1914, and six months of 1915 (of which there is a table later on). Mr. Faucette finally concludes:

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[1] Not printed.

In conclusion, it seems that the many factors entering into this broad question are so strong as to warrant the Corps of Engineers and the Secretary of War to recommend an examination of Savannah Harbor for water deeper than 26 feet at mean low water. We understand that the dredged width opposite the city is about 400 feet. This should of necessity be widened in accordance with what depth is undertaken, and correspondingly greater width as it approaches the mouth of the river, if there are at present any restricted passageways. As to what depth greater than 26 feet should be considered, this is a matter which the Corps of Engineers can more correctly determine from the data submitted, but it seems that any project now to be examined should be calculated certainly on a basis not less than 30 feet or 32 feet at mean low water; and to this end, in behalf of the Seaboard Air Line Railway, I submit this for your consideration, believing that the ultimate good to the port, State, and the United States warrants the same.

10. Mr. E. B. Pleasants, chief engineer Atlantic Coast Line Railroad Co., sent a letter to this office on the subject matter of the hearing, and it is herewith marked "Appendix No. 2."[1] He calls attention to the large terminals of his road, the adjacent large manufacturing establishments of fertilizers, and the need of not less than 26 feet of water for Savannah Harbor.

11. With reference to the draft of ships using the harbor of Savannah, the following table has been compiled from statement furnished me by the Pilots' Association, covering a period of 30 months, January 1, 1913, to July 31, 1915:

Year.	Vessels drawing—						Maximum draft.	
	18 feet and under 20 feet.	20 feet and under 22 feet.	22 feet and under 24 feet.	24 feet and under 26 feet.	26 feet and under 28 feet.	28 feet and under 30 feet.	*Ft.*	*in.*
1913	119	115	94	54	12	2	29	0
1914	68	104	68	55	16	0	27	9
1915	64	49	34	14	2	4	28	4
Total, 30 months	251	268	196	123	30	6		

12. The collector of customs of the port of Savannah also spoke at the hearing and submitted the substance of his remarks in writing (see minutes),[1] in which he called attention to the growth in tonnage of the ships frequenting the port. His table shows that while between 1905 and 1914 the number of foreign entries has increased by only 25 ships, from 106 to 131, the tonnage has gone up from 172,185 to 350,791, an average increase of over 1,000 tons in the ships using the harbor.

13. One speaker at the hearing, Mr. George Elton, city alderman, suggested that any material increase in width and depth of the improvement might damage the wharves by undermining or removing the supporting soil near them, and that some action on the part of local interests might be necessary to remedy the condition. Since the hearing several wharf owners have expressed their willingness to stand any loss or expenditures necessary to allow dredging to any depth or width recommended. This attitude is well illustrated by

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[1] Not printed.

the letter of V. C. Tompkins, assistant general freight agent, Seaboard Air Line Railway, which states as follows:

> Following our conversation of this morning I take pleasure in advising you that I am authorized to say for the Seaboard Air Line Railway that our company will be glad to do such additional dredging in our island slips as will be necessary to conform to the channel provided by the Government in river proper, whether it be 26 feet or 30 feet, which I understand is the maximum depth proposed.

No objection is expected by any wharf owner to any enlarged plan of improvement that may be adopted. This can be covered, if found necessary, by a suitable proviso in the act adopting such a project.

14. As no representative of the city government appeared at the hearing, a letter was addressed the mayor inclosing copy of the suggestions made at the hearing and requesting any sugestions or discussion that seemed to him desirable. Copy of his reply is attached, marked "Appendix No. 3."[1] It will be noted that he concurs in the main suggestions brought forward at the hearing, namely: Existing depth to Quarantine; increase of depth beyond that point to a minimum of 3 feet; width of channel to be 500 feet, widened at bends; mooring facilities at and below Fort Oglethorpe (Jackson). Instead of the widening of the channel at the foot of West Broad Street, however, attention is called to the turning basin already reported upon and recommended upon condition that local interests furnish the necessary land. (See H. Doc. No. 290, 63d Cong., 1st sess., referred to in par. 3.) In support of his suggestions, the growth of commerce in tonnage and value as rapid as previous improvements permitted, and the fact that Savannah is served by several trunk-line railroads, rendering her harbor a logical one to be developed for large freighters, are cited.

15. *Commerce.*—The following quotation from the last annual report gives the essential facts of present commerce. For comparison the totals of the calendar years 1912 and 1913 are added. There is no question but what the falling off in commerce during 1914 is entirely due to the war conditions of Europe during the past year:

> *Commercial statistics.*—The regular line of steamships established between this port and New York, Boston, Baltimore, Philadelphia, and Jacksonville comprise a total of 16 steamers. During the calendar year of 1914, 9 of these ran to the first two ports and 7 to the last three. During the year they carried 1,146,517 short tons of freight, valued at $279,550,356. They also handled in and out of Savannah 64,625 passengers.
>
> A regular steamboat service is maintained on the Savannah River between Savannah and Augusta, Ga., a distance of 202 miles; a regular freight service is maintained between Savannah and the principal ports of the United Kingdom and Continent of Europe, and in addition there is a fleet of American coastwise sailing vessels which operate between Savannah and northern ports.
>
> On the inland waters there are a number of small steamers plying between Savannah and adjacent ports, besides numerous schooners and small sailboats. It is estimated that for the year 1914 this portion of the commerce amounted to 159,956 tons, valued at $5,100,440.
>
> The chief articles of export are cotton, lumber, and naval stores, of which shipments for the year 1914 were as follows: Of cotton, 1,093,469 bales; of lumber, 150,257,181 feet; and naval stores, 129,589 barrels of turpentine and 827,591 barrels of rosin.

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[1] Not printed.

Comparative statement.

Calendar year.	Total commerce.	
	Short tons.	Value.
1912	3,120,676	$296,444,106
1913	3,154,089	360,536,275
1914	2,478,535	349,193,325

16. A detailed description is given of the terminal and transfer facilities of Savannah Harbor on page 707 of House Document No. 226, Sixty-third Congress, first session, which was compiled during November, 1912.

Since that time the three main railroads entering Savannah, viz, the Central of Georgia, Seaboard Air Line, and Atlantic Coast Line, have each made additions to their terminals, the Central of Georgia having added an entire new loading slip, the portion of the adjacent wharves between low water and decking being constructed of concrete. A new warehouse and docks have also been constructed by them for the Merchants & Miners Transportation Co. terminals; the Seaboard Air Line Railway Co. has extended and deepened its slips, and the Atlantic Coast Line has rebuilt portions, adding special mechanical loading and unloading devices. The depths at present in front of the wharves and in the slips vary from 21 to 25 feet at mean low water.

The City of Savannah owns and maintains a municipal wharf in the heart of the city, 385 feet in length, the depth of water in front of this dock being 26 feet at mean low water. Along the portion of the harbor where the 21-foot project is to be obtained, there is owned by the city a strip of land for municipal wharf purposes should future developments require same.

17. The commerce of Savannah has shown a steady and consistent growth, keeping pace with the improvements heretofore provided. It is believed, in view of all that precedes and the fuller facts and arguments given in minutes of the public hearing, that some modifications in the present project, looking to increased facilities, are advisable. Whether the full extent of the wishes of local interests can be met without undue cost can not be decided without a survey. It is, therefore, recommended that a survey be authorized, as necessary to determine the cost and worthiness of the improvements desired, or of such modifications of them as may seem desirable at the time. The dimensions of channel as desired by local interests are suitable at mean low water to vessels drawing 25 feet, and at mean high water to vessels drawing 28 to 30 feet. The length of the vessels may be from 400 to 600 feet.

18. In accordance with law, I report that there are no questions of water power, drainage, or other subject that can be coordinated with the improvement so as to reduce the cost and compensate the Government for expenditures made in the interests of navigation.

W. C. Langfitt,
Colonel, Corps of Engineers.

[Second indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
September 14, 1915.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. For reasons stated herein, the board concurs with the district officer, who is also the division engineer, in recommending a survey in order to determine the extent and advisability of the improvement.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member Present.

SURVEY OF SAVANNAH HARBOR, GA.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Savannah, Ga., June 27, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army.
Subject: Survey of Savannah Harbor, Ga.

1. The river and harbor act of March 4, 1915, provided for a preliminary examination of Savannah Harbor. The report thereon recommending a survey was approved and the survey authorized by letter from office, Chief of Engineers, dated September 21, 1915. The survey has been completed and the following report is submitted.

2. The work was under the immediate direction of Mr. W. C. Lemen, assistant engineer, who prepared a complete and valuable report, from which the following is largely taken, direct extracts being indicated by quotation marks.

3. The report on preliminary examination covers the following subjects and attention is invited thereto, viz: Location, original condition, previous projects, present projects, condition at end of last fiscal year (1915), list of congressional documents, commerce, and terminal and transfer facilities. No additional data of importance has developed other than as discussed below.

4. At the public hearing held in connection with the preliminary examination there was a practical unanimity in the demand for:

(*a*) From the Seaboard Air Line Railway bridge to Quarantine: Channel to be 500 feet wide and 26 feet deep at mean low water, the present project depth.

(*b*) From Quarantine to sea: Channel to be 30 feet deep, 500 feet wide, with suitable widening at turns.

(*c*) Local widening to 1,000 feet at West Broad Street, in lieu of turning basin proposed and recommended in House Document No. 290, Sixty-third Congress, first session.

(*d*) Mooring dolphins at Five Fathom Hole near Fort Oglethorpe, together with local widening to 900 feet or 1,000 feet for 2,000 feet, depth to be 30 feet.

No changes were requested in the Savannah Harbor 21-foot project, from the Seaboard Air Line Railway Bridge to the foot of Kings Island.

5. The survey was designed principally to determine the work and cost to comply with these requirements, except as follows:

First. It is not believed necessary to make the general width 500 feet between the Seaboard Air Line Railway bridge and Quarantine. A width of 400 feet, with perhaps some widening at the sharper turns, is considered ample and has been adopted in the estimates.

Second. Widening to 1,000 feet at West Broad Street was on the face of it extreme, therefore the maximum width considered was 800 feet, together with smaller widths of 700 feet and 600 feet.

Third. At the mooring dolphins proposed at Five Fathom Hole widening to 900 feet only was considered.

6. In addition to the ususal topographic and hydrographic work, borings were taken at the two localities where widening is desired, that is, opposite foot of Barnard Street and at Five Fathom Hole.

The results of this boring work are shown upon sheets 6 and 7, with tabulations showing the character of the material encountered at the various depths. In general, the material at the upper widening is an underlying strata of very stiff, heavy clay, interlaid with stratas of soft sandstone, overlaid by a mixture of mud and sand, on top of which is found sand to various depths up to the natural surface of the ground. On top of the natural surface has been deposited ballast from incoming ships, which it will be necessary to remove by entirely different methods from those which can be applied to the natural ground. In addition, a number of old piles, bulkheads, and wrecks were encountered. The amounts of various materials will be shown in tabulated form later on.

No borings were taken up above low-water line, but it is thought that by plotting the strata of material encountered in the river bed, and determining at what depths and what incline they lay, the character of material on Hutchinson Island proper can be fairly well determined. These cross sections are shown on sheets submitted herewith. (Not forwarded.)

In addition to the above hydrographic work the entire shore lines were rerun from King's Island to Tybee; all the training walls, spurs, and cut-off dikes were relocated, and examination and notes made as to their condition so as to be able to estimate necessary repairs or changes in same. This data is given in tabulated form in tables Nos. 1 and 2.

TABLE No. 1.—*Showing brush and stone work necessary in raising training walls, spur dams, etc.*

Location.	Bank.	Mileage from city, foot of Bull Street.	Number of piles	Linear feet waling.	B. M. feet waling.	Number of waling bolts.	Cubic yards 1-man stone.	Tons stone.	Elevation of brush above low water.	Cubic yards of brush, allowing 2 feet in excess.	Length of portion to be improved.	Total length section.	Width of training wall.	Spacing center to center of piles.	Average width of river.
Spur dams below Screven Cut-Off:											*Feet.*	*Feet.*	*Feet.*		*Feet.*
No. 1	L. B.	1½–2½	....	....	....	....	60	94	....	....	100	....	....	....	700
No. 2	L. B.	1½–2½	....	....	....	....	81	126	....	....	70	....	....	....	750
No. 3	L. B.	1½–2½	....	....	....	....	93	141	....	....	70	....	....	....	750
No. 4	L. B.	1½–2½	....	....	....	....	75	117	....	....	60	....	....	....	850
No. 5	L. B.	1½–2½	....	....	....	....	109	170	....	....	100	....	....	....	750
No. 6	L. B.	1½–2½	....	....	....	....	131	204	....	....	120	....	....	....	750
No. 7	L. B.	1½–2½	....	....	....	....	87	135	....	....	50	....	....	....	750
No. 8	L. B.	1½–2½	....	....	....	....	112	175	....	....	70	....	....	....	750
No. 9	L. B.	1½–2½	....	....	....	....	34	54	....	....	40	....	....	....	750
No. 10	L. B.	1½–2½	....	....	....	....	180	280	....	....	100	....	....	....	850
No. 11	L. B.	1½–2½	....	....	....	....	215	339	....	....	120	....	....	....	900
First opening behind Barnwell Island No. 1	L. B.	3–3½	4	....	....	....	175	273	6.0	1,810	470	470	10.0	....	1,000
Second opening behind Barnwell Islands Nos. 1 and 2	L. B.	3½–3½	....	....	....	....	80	125	6.0	815	230	500	10.0–8.5	....	1,500
Training wall head, Elba Island	R. B.	4½	....	....	....	....	281	440	6.5	1,652	950	810	8.0	....	1,600
700 feet new shore protection head, Elba Island	R. B.	4½	238	1,190	2,380	238	280	430	6.0	2,630	715	715	8.0	6.0	1,350
Breaks for new shore protection head, Elba Island:															
No. 1	R. B.	4½	34	170	340	34	30	47	6.0	277	100	100	8.0	6.0	1,350
No. 2	R. B.	4½	18	90	180	18	18	28	6.0	169	55	55	8.0	6.0	1,350
No. 3	R. B.	4½	34	170	340	34	30	47	6.0	269	100	100	8.0	6.0	1,350
No. 4	R. B.	4½	31	160	320	32	30	47	6.0	256	95	95	8.0	6.0	1,350
No. 5	R. B.	4½	9	50	100	10	10	15	6.0	68	25	25	8.0	6.0	1,350
No. 6	R. B.	4½	15	80	160	16	14	22	6.0	121	45	45	8.0	6.0	1,350
Spur dams below south channel:															
No. 1	R. B.	4½	14	....	....	....	15	24	6.5	200	50	40	8.0	....	1,350
No. 2	R. B.	4½	14	....	....	....	15	24	6.5	200	50	40	8.0	....	1,350
No. 3	R. B.	4½	16	....	....	....	18	28	6.5	216	60	50	8.0	....	1,350
No. 4	R. B.	4½	14	....	....	....	15	24	6.5	168	50	55	8.0	....	1,350
No. 5	R. B.	4½	20	....	....	....	21	33	6.5	235	70	80	8.0	....	1,350
No. 6	R. B.	4½	24	....	....	....	30	46	6.5	350	100	90	8.0	....	1,350
No. 7	R. B.	4½	16	....	....	....	15	24	6.5	158	50	30	8.0	....	1,350
No. 8	R. B.	4½	16	....	....	....	18	28	6.5	199	60	40	8.0	....	1,350
North Elba Island training wall	L. B.	6½–9	18	....	....	....	300	450	6.5	2,570	1,000	11,470	7.0	....	1,400
Spur dams above Girls' House:															
No. 1	R. B.	8½	....	....	....	....	12	19	6.5	154	60	55	5.5	....	1,350
No. 2	R. B.	8½	....	....	....	....	12	19	6.5	154	60	45	5.5	....	1,350

No. 3	R. B.	8¼					12	19	6.5	154	60	40	5.5		1,350
No. 4	R. B.	8¼					8	13	6.5	126	40	30	5.5		1,350
No. 5	R. B.	8¼	40				8	13	6.5	116	40	40	5.5		1,350
No. 6	R. B.	8¼	1				8	13	6.5	116	40	50	5.5		1,350
No. 7	R. B.	8¼					10	15	6.5	140	50	40	5.5		1,350
No. 8	R. B.	8¼					12	19	6.5	144	60	50	5.5		1,400
No. 9	R. B.	8¼					12	19	6.5	129	60	60	5.5		1,400
No. 10	R. B.	8¼	1				10	15	6.5	129	50	50	5.5		1,400
No. 11	R. B.	8¼	3				12	19	6.5	148	60	60	5.5		1,400
No. 12	R. B.	8¼					10	15	6.5	128	50	50	5.5		1,400
No. 13	R. B.	8¼					14	20	6.5	169	70	55	5.5		1,400
No. 14	R. B.	8¼	2				14	20	6.5	163	70	70	5.5		1,400
No. 15	R. B.	8¼					12	19	6.5	144	60	65	5.5		1,400
No. 16	R. B.	8¼					18	28	6.5	154	90	90	5.5		1,400
No. 17	R. B.	8¼	2				21	33	6.5	272	100	95	5.5		1,400
Total			584	1,910	3,820	382	2,777	4,328		14,903	6,196				
Unit price			$6		$30 per M.	$0.12½		$2.50		$1					
Total cost			$3,504		$114.60	$47.75		$10,820		$14,903=$29,389.35, or in round numbers $30,000.					

TABLE No. 2.—*Showing work necessary to be done in raising training walls, etc., with rock.*[1]

Location.	Bank.	Mileage from foot of Bull Street.	Cubic yards of rock.	Tons of rock.	Elevation above low water.	Length to be improved.	Total length of section.	Average width of river.
					Feet.	*Feet.*	*Feet.*	*Feet.*
Lower end Fig Island training wall.	L. B.	3	3,545	5,628	6.0	1,520	1,575	1,000
Mackey Point jetty	R. B.	4½	900	1,404	6.0	600	600	1,700
Lower end Venus Point training wall.	R. B.	10¾	400	524	6.5	700	1,300	1,600
Dam No. 26	R. B.	11	2,044	3,188	6.5	1,100	900	1,550
Dam No. 28	R. B.	11¾	744	1,116	6.5	250	250	2,300
Long Island Crossing	L. B.	11 -13¾	25,820	38,730	6.5	7,450	7,450	1,800
Cockspur Island training wall	R. B.	14½-16¼	16,133	24,200	....	12,100	12,100	2,400
Oyster bed training wall	L. B.	14½-16¼	50,000	75,000	....	5,100	11,900	2,400
Total		....	99,586	149,790	....	28,820	36,075	....
Unit price		....	....	$2.75				
Total cost		....	....	$411,922.50, or, in round numbers, $412,000.				

[1] Not included in Table No. 1.

Five main sheets giving results of the survey are herewith, together with two additional sheets showing two localities on an enlarged scale.[1]

7. The three items (*b*), (*c*), and (*d*), of paragraph 4, are more or less local in nature and lend themselves readily to separate estimates of cost and discussion. They will therefore be taken up in order named.

8. The character of the material of the bottom from quarantine station to the sea has been fairly well determined by the operation of the dredges in the past, it being found that generally the underlying material at a depth of about 22 to 26 feet below mean low water consists of heavy blue clay, and while fairly tough is readily removed by the dredges, making use of the special scrapers designed for this work. Probably the character of the material from 26 feet on down is of the same class as indicated by that which has been found when overdepths have been obtained. Considered as a whole, all the material, with small exceptions of the ballast rocks, wrecks, piling, etc., will be readily removable by means of hydraulic dredges. Table No. 3 gives the estimate of cost for this part of the channel, including suitable widening at turns.

TABLE No. 3.—*Thirty-foot channel quarantine to sea.*

Length.	Width.	Depth at low water.	Yardage.	Unit cost.	Cost.	
Feet.	*Feet.*	*Feet.*		*Cents.*		
5,800	500	30	56,000	9	$5,040	Quarantine channel (pipe-line dredge).
12,400	500	30	1,022,000	9	91,980	Tybee Knoll (pipe-line dredge).
9,400	500	30	416,000	12	49,920	Tybee Knoll (seagoing dredge).
17,000	500	30	1,347,000	12	161,640	Roads (seagoing dredge).
9,600	500	30	351,000	12	42,120	Bar (seagoing dredge).
....	....	....	3,192,000	....	350,700	

[1] Only sheets Nos. 2, 6, and 7 printed.

NOTE.—At this date, in addition to above, 203,000 cubic yards of material will have to be removed to obtain 26-foot depth, at a cost of $20,000.

The Quarantine Channel has been dredged to 400 feet width, and the Knoll, Roads, and Bar to 500 feet, and in depth to 26 feet at mean low water. It is believed that the reasons for asking for the increased width and depth as set forth by Capt. Frank W. Spencer, of the Pilots' Association, given in paragraph 8 of the report on preliminary examination, are sound. In addition, it is well recognized that increased depth on ocean bars is necessary over that of inner channels to prevent even ordinary roughness of the sea causing delays or damage due to the "send" of the vessels. I believe this portion of the desired changes worthy of adoption.

9. In the following table is given in detail the cost of widening the channel at Barnard Street to 800 and 700 feet from the south harbor line, both tapering off to a width of 600 feet; and making it 600 feet wide throughout, this being the width between the harbor lines above and below.

TABLE No. 4.—*Barnard Street widening.*

Material.	800-foot widening.			700-foot widening.			600-foot widening.		
	Cubic yards.	Unit price.	Cost.	Cubic yards.	Unit price.	Cost.	Cubic yards.	Unit price.	Cost.
Sand	171,000	$0.08	$13,680	153,000	$0.08	$12,240	132,000	$0.08	$10,560
Sand and mud	657,000	.08	52,560	529,000	.08	42,320	412,000	.08	32,960
Mud	37,000	.10	3,700	27,000	.10	2,700	24,000	.10	2,400
Sand and hard-shell	12,000	.25	3,000	10,000	.25	2,500	8,000	.25	2,000
Blue clay	119,000	.30	35,700	82,000	.30	24,600	43,000	.30	12,900
Sandstone	19,000	.60	11,400	14,000	.60	8,400	8,000	.60	4,800
Total	1,015,000		120,040	815,000		92,760	627,000		65,620
To remove 30,000 cubic yards of ballast on top, at 25 cents			7,500			[1] 4,500			
1,007 old piles, at $1			1,007			1,007			1,007
1,970 linear feet of bulkheads, at $1			1,970			1,970			1,970
9 wrecks, at $50			450			450			450
Total			130,967			100,687			69,047
For unexpected difficulties, 10 per cent.			12,828			10,068			6,906
Grand total			144,927			110,755			75,952

[1] Ballast not included.

NOTE.—Cost of right of way not included.

The present width at this point between shore lines is only 500 feet. It is believed that the widening to 600 is sufficient for the purposes desired. Moreover, as the widening combined with the moorings and widening at Five Fathom Hole are to replace the turning basin already recommended to Congress (H. Doc. No. 290, 63d Cong., 1st sess.), at a cost of $154,000, the combined cost of the substitutes now desired will certainly not exceed the cost of the former less satisfactory basin. I am of the opinion that the widening to 600 feet should be adopted. It should be noted, however, that to accomplish this widening will require the acquisition of a certain amount of private property. This, it is believed, should be furnished by local interests.

10. The character of the material at the mooring dolphins opposite Fort Oglethorpe was very readily obtained, and is shown on its special sheet. Table No. 5 gives cost of creating this mooring and anchoring basin.

TABLE No. 5.—*Mooring dolphins and turning basin opposite Fort Oglethorpe.*

Length.	Width.	Character of material.	Cubic yards.	Unit price.	Cost.	Remarks.
Feet.	*Feet.*			*Cents.*		
1,000	900	Sand and mud with strata of blue clay.	558,000	10	$55,800	Dredged to 30 feet, allowing 1 foot overdepth.
Mooring dolphins					3,000	
Total					58,800	
10 per cent for unexpected difficulties.					5,880	
Grand total					64,680	

In this case also I believe that the arguments of Capt. Spencer are sound and, taken in conjunction with the elimination of the former proposed turning basin, give good grounds for adopting this mooring basin.

11. Considering generally the changes desired, having in view more especially the maintenance of the resulting channel, a study of the past results has been made.

A comparison of the present condition of Savannah Harbor with its condition as indicated in survey of 1905, prior to the commencement of the present project, shows that in 1905 there was an average depth from Savannah to the sea of 23.3 feet, while the corresponding average by the recent survey is 28 feet, the total distance of the improvement being 135,000 feet—26.2 miles. This does not include the portion of the harbor known as the 21-foot project, covering the river from the Seaboard Air Line bridge up to the foot of Kings Island.

A study of the high and low water planes from Tybee to the vicinity of Kings Island has been carried on since 1890 by means of automatic tide gauges set at various localities. The results of the observations for 1903–1905 and 1914–15 are shown in the following table:

Table No. 6.

	Waterworks.		Fort Oglethorpe.		Fort Pulaski.		Tybee Knoll.		Beacon, Tybee front.[1]	
	High water.	Low water.	High water.	Low water.	High water.	Low water.	High water.	Low water.	High water.	Low water.
1903–1905	7.13	1.19	6.98	0.71	6.80	0.05				
1914	7.04	.62	6.91	.58	6.55	.01	6.74	0.07		
1915	7.28	.90	7.12	.85	6.81	.31	6.91	.27	6.78	0.00

[1] November, 1913, to July, 1915.

These observations were used in determining what has been styled the standard high and low water plane of 1916. From this table and profile it will be noticed that the mean plane of reference has not changed materially from Fort Pulaski to Fort Oglethorpe, but on the upper portion of the harbor, especially in the vicinity of waterworks and above, the plane is lowering, this change gradually increasing from Fort Oglethorpe up. Undoubtedly this lowering of the low-water plane is due to the execution of the 26-foot project and the work on the 21-foot project in the Marsh Island and Kings Island channels. These results are platted on a profile and marked "Planes of high and low water, Savannah Harbor, for the fiscal years 1903–1905 and 1914–15." It must be noted that the observations at Tybee Knoll gauge are scant and unsatisfactory, and absolute dependence can not be placed in them. The data at hand indicates a reverse slope at the high water in this locality. This lowered "low-water" plane has been adopted for the estimates herein given and should be used in future as the adopted plane of reference.

12. The following table gives the total amount of material removed by dredging by contract and Government plant since the survey of 1905, upon which the present project, 26-foot depth at mean low water, is based:

No. 7.—Table of dredging, Savannah Harbor, Ga., at localities named.

Year.	Marsh Island Channel.	City Front.	Wrecks Channel.	Five Fathom Hole.	Obstructions Channel.	The Bight.	Upper Flats.	Pocket between Flats.	Lower Flats.	Pocket at Venus Point.	Long Island Crossing.	Quarantine Channel.	Tybee Knoll.	Tybee Roads.	Tybee Bar.	Total.
1906	....	....	....	....	33,000	....	218,191	....	....	....	27,922	....	398,938	....	129,446	807,497
1907	....	....	....	....	....	....	70,000	....	119,000	....	156,000	....	364,317	....	271,757	981,074
1908	....	....	....	....	....	....	81,000	....	85,000	....	166,000	....	384,686	....	388,363	1,105,049
1909	....	....	....	....	54,997	....	84,616	....	93,706	....	424,536	204,400	61,275	706,936	109,583	1,740,049
1910	....	36,542	....	....	31,355	....	56,988	....	75,960	....	261,843	206,608	299,610	783,385	165,022	1,917,313
1911	....	....	....	107,666	548,326	....	392,856	....	....	....	275,801	880,833	545,193	286,857	280,932	3,318,454
1912	....	523,680	493,112	....	....	....	209,873	....	853,770	....	406,792	....	980,554	516,801	75,162	4,059,744
1913	53,722	392,757	318,238	....	35,176	337,427	25,464	....	756,979	....	636,048	....	636,043	410,692	139,537	3,742,083
1914	957,104	....	....	....	....	866,538	....	....	172,651	....	683,854	....	590,402	166,724	111,554	3,548,827
1915	124,358	....	....	3,736	....	....	83,876	....	219,338	....	255,680	....	487,911	247,257	502,618	1,924,774
Total.	1,135,184	952,979	811,350	111,402	702,854	1,203,965	1,222,864	....	2,376,404	....	3,294,476	1,291,841	4,748,929	3,118,652	2,173,964	23,144,864
														10,041,545		
Original estimate...	749,290	748,384	644,400	102,058	508,300	870,614	870,614	129,500	632,448	148,000	1,341,000	675,719		6,150,000		13,570,327
Difference..	385,894	204,595	166,950	9,344	194,544	333,351	352,250		1,743,956		1,953,476	616,122		3,891,545		9,574,537

Fill, 766,783=8 per cent

Fill, 4,916,209=51.4 per cent

Fill, 3,891,545=40.6 per cent

13. Up to the end of the fiscal year 1915, 23,410,106 cubic yards of material had been removed from the channel from the Seaboard Air Line bridge to the sea buoy. The estimated amount necessary to be removed to obtain the 26-foot channel, as given in the original report (H. Doc. 181, 59th Cong., 1st sess.), was 12,555,000 cubic yards, which, taken from the amount removed, plus 1,851,000 cubic yards, estimated to be necessary to be removed June 30, 1915, to complete the project depths and widths, indicates a total shoaling in 10 years of 12,406,000 cubic yards, giving an annual mean shoaling of 1,240,000 cubic yards. This, however, does not represent the amount of shoaling that will probably be necessary to be removed in the future, as the following tabulation, prepared from annual reports, indicates that this shoaling has been steadily increasing since commencement of the improvement, and rapidly increasing in the last few years, until the estimate made in 1915 indicates that there is approximately a million and three quarters cubic yards shoaling annually. Undoubtedly the deeper the channel the larger the amount deposited by the river in the improved channel. Other reasons for this apparent rapid increase in the amount of deposit will be given further on in this report, and suggestions made as to a remedy.

TABLE No. 8.—*Annual shoaling Savannah Harbor.*

[1907–1915 inclusive.]

Year.	Scour.	Total dredging.	Net shoaling.	Annual fill for 5 years.	Annual fill for 8 years.	Annual fill for 9 years.
	Cu. yds.	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*
1907			[1] 260,000			
1908			[1] 260,000			
1909			[1] 260,000			
1910	1,179,500	1,916,913	737,413			
1911			[1] 950,000			
1912				521,000		
1913	2,776,445	3,742,083	965,638		733,500	
1914			1,373,000			873,100
1915	208,181	1,924,771	1,716,590			

[1] Approximate.

From annual studies which have been carried on regularly it is known that the main shoaling in Savannah Harbor occurs at certain well-defined points, though slight shoaling and scours occur throughout the entire length of the improved channel. These main points are the inner end of Tybee Knoll, mileage 17, just at the entrance to the two jetties; Long Island Crossing, mileage 11; Lower Flats, mileage 9; Upper Flats, mileage 7; Obstructions, mileage 4, just opposite the entrance to South Channel; also the lower end of that portion called the City Front, mileage 2.

14. The main reason for shoaling in the channel is no doubt the loss of volume due to the "South Channel," which formerly was the main channel and which has never been entirely closed.

"The general plan of improvement of Savannah Harbor has been to divert from the main Savannah River at Cross Tides to Front River by means of Cross Tides Dam a large portion of the natural flow that formerly went into Back River; to prevent, by cut-off dams, the flow of any portion of the Back River water back of the Barnwell Islands, thus bringing the entire amount of the Savannah River flow into Front River at the lower end of Fig Island training wall. This flow is again partially prevented from escaping down South Channel from this combined channel by means of the Mackey Point training wall and the submerged dam a few thousand feet down South Channel, and is contracted in the North Channel below this subdivision by means of parallel training walls and by the closing of the opening formerly existing between Spirit Island and South Elba Island, known as Duck Puddle.

"Every project and modification of projects has followed this general plan and touches upon the amount of ebb tide flow lost down the South Channel. Everyone apparently appreciates the detrimental effect of this loss of flow to the North Channel. With a view of remedying same there was constructed in 1881 a submerged dam across South Channel, of which is said in the Annual Report of the Chief of Engineers for 1881, part 2, page 1085, as follows:

"'This dam stands the current (here very strong) perfectly and is having the desired effect upon the currents, so far as it has been completed.

"'The design in locating this dam was to allow a free passage for the flood-tide flow up the main channel and to obstruct as much of the last quarter of the ebb tide as possible and deflect it into the North Channel to aid in the scour of that channel; at the same time the dam was not to be raised so high as to impede the passage of the inland steamers. When these conditions have been fully complied with it is believed the dam will be found very efficient as an aid to the improvement of the northern channel.'

"In 1894 and 1907 this flow was further restricted by the construction of pile, brush, and rock dams at the mouth of the South Channel.

"In the Annual Report of the Chief of Engineers for 1890, page 1258 et seq., etc., is given the revised project of improvement for Savannah Harbor and River with a view of obtaining a channel depth of 26 feet (at mean high water). In the report of the officer in charge the following recommendation is made:

"'To construct a deflecting jetty running out toward South Channel from Mackeys Point in order to divert a greater ebb volume into North Channel.' (Annual Report for 1890, p. 1261.)

"In this report quite elaborate observations were made as to the tidal movements of Savannah River, both ebb and flood, following quantities are taken from this report, pages 1279 and 1289. The discharge of North Channel, after passing the mouth of South Channel, is given as 1,163,343,000 cubic feet. The discharge through South Channel is given as 768,384,000 cubic feet, showing the total discharge of the river above South Channel to be 1,931,727,000 cubic feet, which shows that approximately 40 per cent of the flow was escaping down South Channel.

"At the time of these observations the submerged dam, as heretofore described, had been constructed in South Channel. Since these observations the extension and the building of Mackey's point rock jetty, and the pile and brush jetty on the opposite shoal, has probably reduced to a certain extent the percentage of loss due to South Channel, though both of these jetties have in recent years deteriorated and do not restrict to any great extent except after a low-water stage has been obtained. In addition, the submerged dam, constructed some 1,000 or 1,200 feet from the mouth, has subsided, largely destroying its effect for this reduction, so it may be considered that approximately the same ratio or, say, at least 30 per cent of the present flow of Savannah River is lost down South Channel.

"Examining these discharges further, it is found that of the 768,384,000 cubic feet going down South Channel, 346,297,000 escaped into St. Augustine Creek, leaving 417,638,000 flowing down South Channel proper. In other words, 45 per cent of the flow down South Channel escaped by St. Augustine Creek."

15. Still further emphasis of the detrimental effect of the division of flow due to South Channel and St. Augustine Creek is given in the report, and the benefit of the closure of South Channel in the maintenance of depths on the Knoll is discussed. It does not seem necessary to further emphasize the desirability of the closure in whole or in part of these channels, so far as their connection at the upper end with Savannah River is concerned. The increased flow down North Channel, it is believed, could have only beneficial effects all through. The channel is ample to take care of the greatest discharges to be expected, and the works of improvement have been so consolidated by time or covered by deposits as to be safe from injury.

16. The most suitable locality at which to close South Channel below St. Augustine Creek is indicated on sheet No. 2, at the narrow section there found. A dam composed of piles driven as nearly in juxtaposition as practicable and covered with dredge spoil from the vicinity, the finished dam to have a crest 15 feet wide, is estimated to cost $10,000. A rock-fill dam would cost $37,000. Such a dam, it is estimated, would increase the flow down the North Channel by 10 per cent.

17. To close the South Channel at or near its head would, by the first method (pile dam and dredge spoil), cost $10,000. A rock-fill dam, much the best for this locality at least, would cost $37,000. A dam here would practically eliminate the objectionable features due to St. Augustine Creek, but would necessitate the opening of another route for the inside water route from Savannah to Fernandina, Fla. "This is possible by making a connection with the upper end of Habersham Creek, cutting through the old Deptford rice plantation at the point indicated on sheet No. 2, the conversion of the fixed trestle of the Central of Georgia Railroad across Habersham Creek near its mouth into a drawbridge and slight improvement of this creek near its mouth; otherwise Habersham Creek presents ample waterway for the inside route commerce. The estimated cost of this dredging is $35,000, including cost of right of way but not the change in the Central of Georgia trestle. In regard to the bridge, it is found that no permit has ever been issued to the Central of Georgia Railway for the construction of any bridge at this locality. No serious trouble is thought would be encountered in requiring this railroad to convert this into a drawbridge of some description.

"The closing of the South Channel and the opening up of the inside route by this method would increase the ebb tide flow of North Channel approximately 30 per cent, with its consequent certain beneficial effects, and two other minor advantages would be obtained. The inside route would be shortened approximately 5 miles from Savannah to the southward, and for through traffic a somewhat less amount. The large proportion, approximately 51 per cent, of the annual shoaling that is now occurring in the main channel of Savannah Harbor, from Savannah to the sea, occurs on the shoals existing between the entrance of South Channel and the end of the jetties at the Tybee Knoll, and it is believed that the increase of this flow by the amount that now goes down South Channel, estimated at 30 per cent of the total ebb flow, would greatly decrease the annual amount of shoaling, thus decreasing the annual maintenance." On account of its evident advantages the closure discussed in this paragraph is advocated and recommended. Should unforeseen difficulties arise in excavating, or later investigations show it more desirable to close South Channel at some other point, it should be understood that the adoption of the project herein recommended to Congress should permit this or other minor changes.

18. A minor determinant, of which no cure seeems at hand, fixing the position of shoals, is the more or less changeable point of meeting and mingling of the fresh and salt waters. It is believed that the salt water has, on the very fine clays and vegetable matter carried in suspension by the river, a coagulating effect similar to that produced by alum. This meeting and mingling will take place at varying distances from the sea, depending on character of tide, direction of wind, discharge of river, and so on. The character of the material found at the different localities support this conclusion.

"The upper shoals consist of heavy coarse river sand, which, as you progress down the river, becomes lighter in character, mingling with a slush, apparently caused by the decomposition of vegetable matter held in suspension by the river water, until upon the lower shoals and on the bar we find the top strata of the filling to be nothing but this slush, highly charged with what is apparently a sulphurated hydrogen gas. In some instances gas pockets are encountered in dredging of such sizes as to cause the main pumps to lose their vacuum. Unless steady dredging is carried on over an area the removal of this slush with the hopper dredges is very slow and uneconomical comparatively. Where possible it is much more satisfactory to pump this slush ashore with the pipe-line dredges."

19. Another cause of shoaling is due to the deterioration of some of the controlling works and also to the fact, in some degrees at least, that these works were designed for a project contemplating 26-foot depth at mean high water, not mean low water, as at present. For the former project they were well designed and laid out, but reached, to a large degree, their limit of usefulness with its completion.

"The present project has been almost entirely one of dredging, with only a small expenditure for the raising and extending of the training walls, near the mouth of the river, in that portion of the harbor where the teredo is not active, the training walls were originally constructed of double rows of piles filled with brush fascines, weighted with rock. The lower training walls were constructed of rock alone, laid on log and brush mattresses. The upper training walls, with a few exceptions, have served their purpose, the deposit from the river having filled behind them, the marsh has finally grown out to and partially covered them.

"The exceptions are mostly closing dams between islands, where the ebb and flow of the tide has gradually caused the subsidence of the filling, allowing a break to occur in the even flow of the currents.

Almost without exception, we find shoals occurring opposite these points. The points of deterioration are listed in tables Nos. 1, 2, and 3, which give the length of the poor stretches and amount and cost of refilling. These localities exist, almost without exception, in the portion of the channel where the 26-foot depth is considered as sufficient, and while it might be possible, by constant dredging alone, to maintain this depth across the shoals, it is thought more economical, in the long run, to consider the reclosing of them either by pile, brush, and rock dams or by filling with a hydraulic pipe-line dredge."

20. From all the data at hand, the conclusion is reached that the repairs to training walls and extensions and repairs to jetties outlined in tables 1 and 2 are necessary to aid in prosecution of the work desired, as well as in its subsequent maintenance. The cost of these repairs and extensions is $442,000. Closing South Channel is also most necessary, and adopting the better plan for this will cost, including the Habersham Creek cut for the inland waterway, $67,000. It is estimated that it will take three and one-half years to complete the project, supposing two pipe-line dredges and two seagoing hopper dredges are available, and that during this period maintenance work will be necessary amounting to about 6,125,000 cubic yards. With Government dredges this can be removed for 8 cents per cubic yard, or $490,000.

21. The total dredging of all kinds provided for in the work outlined is some ten and one-half million cubic yards. The present plant available—one 20-inch pipe-line dredge (the *Morgan*) and two seagoing dredges (the *Savannah* and *Cumberland*)—is totally inadequate to carry it out in any reasonable time. It ought reasonably to be completed in, say, three and one-half to four years. It is believed this could be done with the addition to the plant of another pipe-line dredge of large capacity. It is believed that such a dredge could be obtained, together with tender and accessories, for the sum of $250,000. I have accordingly placed in the estimate the sum of $250,000. This extra dredge will also be needed afterwards for maintenance work for some years at least. (Par. 23.)

22. Summing up the costs of the various elements of work herein recommended, the following table results. It is to be noted that this includes cost of maintenance for the time—three and a half years—estimated for completion. This at present amounts to about $250,000 annually, and leaves the net estimated cost of the improvement $1,430,000:

Items.	Cost.
1. Barnard Street widening (600 feet)	$76,000
2. Oglethorpe turning and mooring basin	65,000
3. Channel quarantine to sea, 30 feet at mean low water	350,000
4. Repairs to training walls	30,000
5. Repairs and extension of jetties	412,000
6. Closing South Channel	37,000
7. Habersham Cut, including right of way	35,000
8. Shoaling for 3½ years, at 1,800,000 cubic yards per annum, 6,125,000 cubic yards, at 8 cents	490,000
9. One additional 20-inch pipe-line dredge, complete with outfit and tender	250,000
10. 10 per cent for office expenses and contingencies	172,500
Total	1,919,500

Or, in round numbers, $1,920,000.

23. Present maintenance requires the operation of two seagoing hopper dredges and one 20-inch pipe-line dredge, but as the 21-foot part of the project has not been completed no maintenance has been attempted in that portion. Moreover, the present equipment has been found to possess not more than a reasonable margin of capacity. When it is considered that the new project herein presented, if adopted in its entirety, will have the two widenings (Barnard Street and Five Fathom Hole), where local shoaling can be expected to be more or less constant and troublesome, and that the channel from Quarantine to the sea will be much deeper, with consequent increased shoaling, it is believed that, even with the concentration of flow provided for, increased dredging facilities will have to be provided for a few years at least. The following estimate of cost is therefore submitted:

Operation of 2 seagoing hopper dredges	$120,000
Operation of 2 pipe-line dredges (20-inch)	180,000
Surveys, contingencies, repairs to works, etc	50,000
Total	350,000

It is thought that this sum annually will take care of both the 21-foot and 26-foot projects for Savannah Harbor, and possibly after a few years be somewhat reduced. For the seagoing dredges the estimate carries only about three-fourths of their whole time, it being expected that the other fourth of time will be taken up in maintenance work at Brunswick and Fernandina Harbors.

24. It is believed that the work herein outlined and discussed is worthy of being undertaken by the General Government. Appropriations should be made annually as follows, work to be completed in three and one-half years:

	First year.	Second year.	Third year.	Fourth year.
Pipe-line dredge	$250,000			
Maintenance	250,000	250,000	250,000	[1] 300,000
New work	225,000	225,000	225,000	120,000
Total	725,000	475,000	475,000	420,000

[1] Increased by $175,000 to provide for maintenance, remaining half of fourth year.

25. It is recommended that the execution of the widening at Barnard Street be contingent upon local interests providing free of cost any rights of way found necessary, together with convenient place of deposit of spoils. It is not believed that local cooperation other than this is advisable.

W. C. LANGFITT,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors on survey, see p. 3.]

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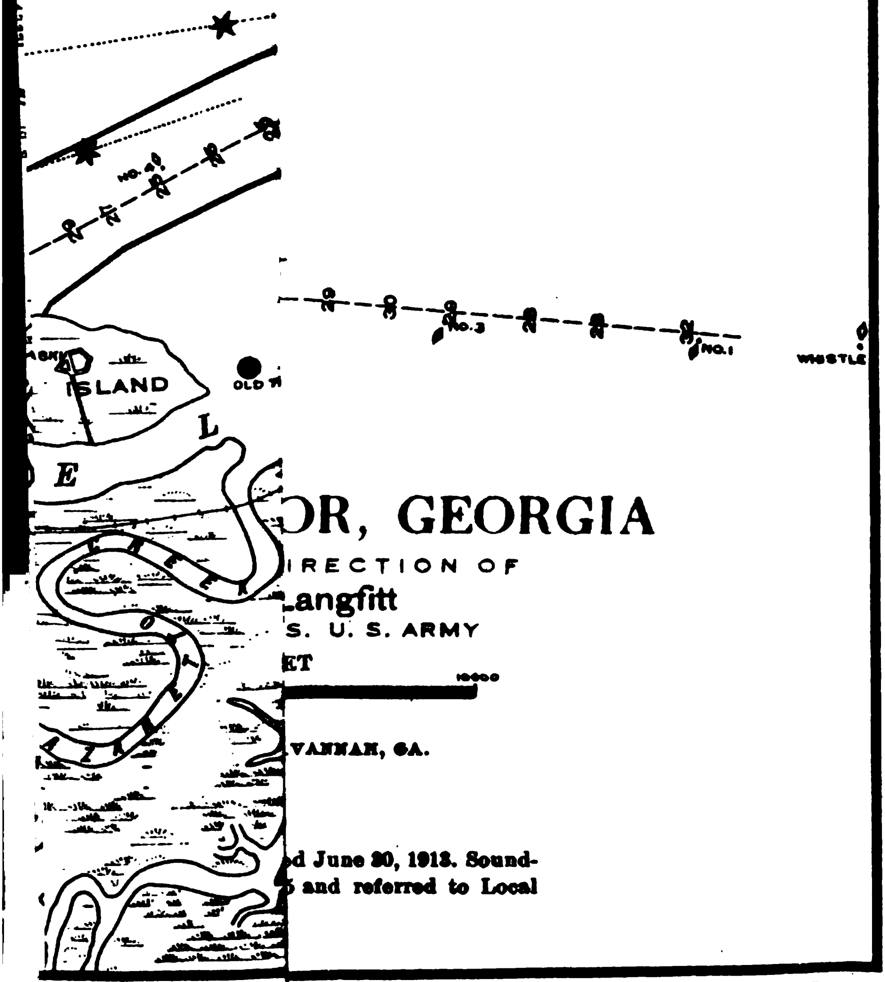

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64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1692.

BAYOU BARTHOLOMEW, LA. AND ARK.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON REEXAMINATION OF BAYOU BARTHOLOMEW, LA. AND ARK.

DECEMBER 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

WAR DEPARTMENT,
Washington, December 7, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated October 17, 1916, together with copy of a report from Maj. H. C. Fiske, Corps of Engineers, dated May 25, 1916, relative to the project for improvement of Bayou Bartholomew, La. and Ark., made by him in compliance with the provisions of the act of Congress approved March 4, 1915.

Very respectfully,.

NEWTON D. BAKER,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, October 17, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of Bayou Bartholomew, La. and Ark.

1. Under authority contained in section 14 of the river and harbor act approved March 4, 1915, there is submitted herewith for trans-

mission to Congress report dated May 25, 1916, by Maj. H. C. Fiske, Corps of Engineers, relative to the project for improvement of Bayou Bartholomew, La. and Ark.

2. Bayou Bartholomew rises in Jefferson County, Ark., and empties into the Ouachita River opposite Ouachita, La. The existing project, adopted by the river and harbor act of March 3, 1881, provides for the removal of obstructions and the cutting of leaning trees from the banks between Baxter and the mouth, a distance of about 182 miles, at an estimated cost of $26,862 for two seasons' work. Improvement has been confined to the section between the mouth and McComb Landing, a distance of about 140 miles, and the total expenditures have been $80,730.78. The average annual commerce reported during the last 10 years amounted to 1,353 short tons, valued at $69,344. The district officer recommends that the project be continued for the present. The division engineer believes that a moderate expenditure of about $2,500 per year is justified by the commercial interests involved.

3. This report has been referred for consideration and recommendation to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated August 22, 1916. The board states that the physical condition of the stream is such that it can not be used for navigation during the time of the year when it is most needed. The commerce is very small and there is no prospect of any increase, and the board believes that the cost of any useful improvement would be far in excess of the resulting benefits to general commerce and navigation. It therefore recommends that the project be abandoned.

4. After due consideration of the above-mentioned reports, I concur in the views of the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the abandonment of the project for improvement of Bayou Bartholomew, La. and Ark.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
August 22, 1916.

To the Chief of Engineers, United States Army:

1. This report on Bayou Bartholomew, La., is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads:

> And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made.

2. Bayou Bartholomew rises in Jefferson County, Ark., flows in a southerly direction, and empties into the Ouachita River near Ouachita, La.

3. The existing project, adopted by the river and harbor act of March 3, 1881, provides for the removal of obstructions and the cutting of leaning trees from the banks from Baxter to the mouth, a distance of 182 miles, at an estimated cost of $26,862 for two seasons' work. A total of $80,730.76 has been expended under this project, an average of about $2,300 a year. The improvement has been confined to the section below McCombs Landing, Ark., about 140 miles in length. The work has resulted in a fairly navigable condition whenever the stages of water would permit boats to run. The available depth at low water is only about 1 foot.

4. In earlier years there was a considerable commerce on this bayou, but it has declined and for several years has averaged less than 500 tons. The crops in the adjacent territory are largely moved during the autumn and early winter when the stages are lowest and boats can not operate. Logs can be floated out at higher stages without improvement. The district officer states that the volume and value of the traffic reported are low in comparison with the cost of the improvement, but he recommends that the existing project be continued for the present. The division engineer believes that an expenditure of about $2,500 per year is justified by the commercial interests involved.

5. Persons interested in this improvement were informed of the present investigation and given an opportunity of submitting statements and arguments bearing upon the necessity and advisability of the United States continuing this improvement. Communications[1] from two parties have been received and given consideration.

6. The physical condition of this stream is such that it can not be used for navigation during the time of year it is most needed. The commerce is very small, and there is no prospect of any increase. The district officer states in a separate communication that it will cost $4,000 a year to continue the project. Some advantage would result from a lesser expenditure, but it is believed that the cost of any useful improvement would be far in excess of the resulting benefits to general commerce and navigation. In view of these conditions, the board recommends legislation authorizing the abandonment of the project for the improvement of Bayou Bartholomew, La.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF BAYOU BARTHOLOMEW, LA. AND ARK.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., May 25, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Reexamination of Bayou Bartholomew, La. and Ark.

1. In compliance with instructions contained in third indorsement from your office, dated May 29, 1915, report is herewith submitted

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[1] Not printed.

on the existing project for the improvement of Bayou Bartholomew, La. and Ark. These instructions were issued under authority of a paragraph contained in section 14 of the river and harbor act approved March 4, 1915, which reads as follows:

> And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable or in which modifications of the plans or projects should be made.

2. The watershed drained by this stream extends over part of the southeast portion of the State of Arkansas and the northeastern parishes of the State of Louisiana. The bayou rises in Jefferson County, Ark., a few miles west of Pine Bluff; following a tortuous course, it flows first in a southeasterly direction nearly parallel to the Arkansas River, then in a southerly direction parallel to the Mississippi River, and after entering Louisiana it turns to the southwest and empties into the Ouachita River in Morehouse Parish, opposite Ouachita, La., 210.3 miles above the mouth of Black River. The section included in the project extends from Baxter, Ark., to the mouth of the bayou, a distance of about 182 miles.

3. Preliminary examinations of this stream have previously been made and reports submitted and published as follows: From the mouth of the bayou to the Arkansas State line, Report of Chief of Engineers, 1872, page 383. This report was favorable to removing snags and leaning timber at an estimated cost of $34,716. From the mouth to Baxter, Ark., House Document No. 61, Forty-fifth Congress, third session. This report was favorable to the removal of snags, sunken logs, and overhanging trees at an estimated cost of $23,005. From the mouth to Baxter, Ark., House Document No. 38, Forty-sixth Congress, third session. Report was favorable to removing snags and wrecks from the channel and leaning trees from the banks at an estimated cost of $26,862. From the head of navigation to the Lincoln County line, House Document No. 147, Forty-eighth Congress, second session. The report was unfavorable.

4. The improvement of this bayou was begun by the United States in 1881, and has since been continued when funds were available and conditions favorable. The work consisted of removing snags, wrecks, and sunken logs from the channel and cutting leaning timber along the banks of the stream. Although Baxter, Ark., is the upper limit of the project and of navigation, no work has been done above McComb Landing, Ark., since 1881, as there has not been any local demand for work above that place. McComb Landing is 140.9 miles above the mouth of the bayou. The sum of $80,730.78 has been expended in improving this stream in the 35 years that the project has been in force, or an average of about $2,300 a year. These expenditures have resulted in keeping the stream in a fairly safe navigable condition whenever the stages of water were sufficient to permit boats to run.

5. During the medium and high-water period, which usually occurs between January and June, a least depth of 8 feet is available for navigation between McComb Landing and the mouth, which is ample for the small steam or gasoline boats used on this stream. At low water this depth is reduced to about 1 foot and little navigation is possible. The range between high and low water is about 32 feet. The bayou is crossed by five swing bridges within the section in-

cluded in the project. Of these bridges four are located below McComb Landing and have draw spans with 60 feet or more clear openings and clear heights of from 0 to 4 feet above mean high water. The Missouri Pacific Railway bridge at Montrose, Ark., a short distance above McComb Landing, has a draw span of 44 feet clear opening and its lowest chord is at the level of mean high water.

6. Bayou Bartholomew flows into the Ouachita River and the latter stream furnishes a navigable approach with a least available depth of about 5 feet at all stages during the entire year. This depth is now secured by the operation of Lock and Dam No. 4, on the Ouachita River 33.3 miles below the mouth of the bayou, and does not extend below the lock and dam. The maximum draft that can be carried at mean low water on the Ouachita River below Lock and Dam No. 4 is about 1¼ feet.

7. The commerce transported on Bayou Bartholomew in former years was large and of great value. Since the construction of railroads through the territory, however, it has steadily diminished. The maximum annual amount of freight carried during the last 10 years was 4,152 short tons and the maximum value $246,501. The average during the same period was 1,353 short tons, with a value of $69,344 per annum. During three of these years no commerce was reported on this stream. There is reason to believe that the commerce on the Bartholomew has never been fully reported. No trustworthy estimate of the tonnage not reported can be made. The freight transported when the stream is used consists of farm products and general merchandise. The work of improving this stream has reduced freight rates about 50 per cent. The greater part of the crops in the country tributary to this stream is moved during the autumn and early winter, when water stages are lowest. When Dam 5, Ouachita River, is built it will give pool water for nearly 12 miles up the Bartholomew. Dam 4, which is now in operation, gives pool water about 1 mile up the Bartholomew. When Locks and Dams Nos. 2 and 3, Ouachita River, now under construction, are completed the mouth of the Bartholomew will be the head of continuous slack-water navigation on the Ouachita River. This fact may lead to an appreciable revival of commerce on this stream if there is a revival of river traffic over the improved Ouachita. While the volume and value of the traffic as reported is low in comparison with the cost of this project, it is probable that if boat operators can be persuaded to submit more nearly complete traffic reports this river will make a better showing. In addition, a firm at Wilmot, Ark., has put a boat on the river this spring, a firm at Baxter talks of doing the same, and there are some faint indications of an increased use of the Ouachita which might affect the Bartholomew.

8. There are no terminal facilities under public control on Bayou Bartholomew; no water-power possibilities are involved in its improvement; and no questions of land reclamation, protection from floods, or other special features have been encountered which require consideration at the present time.

9. Three blue prints[1] of a small sketch map of the bayou are sent herewith. This map was prepared to accompany the annual report

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[1] Not printed.

of this district for the fiscal year ending June 30, 1913. The tracing of the map was sent to the office of the Chief of Engineers, with letter from this office dated July 29, 1913.

10. In view of these facts, I would recommend that the recommendation of the Board of Engineers for Rivers and Harbors on the Ouachita River (H. Doc. 979, 64th Cong., 1st sess.) be extended to apply to this stream—that is, that the existing project be continued for the present and the advisability of continuing it indefinitely be investigated again after there has been an opportunity to note the results of the newly installed boats and also of the complete canalization of the Ouachita River below Monroe, La.

HAROLD C. FISKE,
Major, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, WESTERN DIVISION,
St. Louis, Mo., May 27, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. This bayou is one of a number of streams extending into a section of Arkansas that has very inadequate railroad service. I believe that a moderate expenditure of about $2,500 per year is justified by the commercial interests involved.

C. McD. TOWNSEND,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors, see p. 2.]

O

64th Congress, 2d Session. } HOUSE OF REPRESENTATIVES. { Document No. 1693.

UPPER PASQUOTANK RIVER, N. C.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION OF UPPER PASQUOTANK RIVER, N. C., FROM TURNERS CUT UP TO THE HEAD OF NAVIGATION AT LEBANON ROAD, OR AS FAR AS MAY BE PRACTICABLE.

December 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

War Department,
Washington, December 7, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated October 31, 1916, together with copy of a report from Lieut. Col. J. P. Jervey, Corps of Engineers, dated June 5, 1915, with map, on a preliminary examination of upper Pasquotank River, N. C., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, October 31, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination of upper Pasquotank River, N. C.

1. There is submitted herewith for transmission to Congress report dated June 5, 1915, with map, by Lieut. Col. J. P. Jervey, Corps of

Engineers, on preliminary examination authorized by the river and harbor act approved March 4, 1915, of upper Pasquotank River, N. C., "from Turners Cut up to the head of navigation at Lebanon Road, or as far as may be practicable."

2. The Pasquotank River has a length of about 46 miles, and empties into the northeastern end of Albemarle Sound. It is a nontidal stream, narrow and tortuous in its upper portions, and wide and straight in the lower portions. The stream is under improvement by the United States up to and including Turners Cut, as part of the waterway from Norfolk to the sounds of North Carolina, the project for which provides for a channel 10 feet deep at mean low water. The improvement now apparently desired is a channel about 6 feet deep and 40 feet wide from Turners Cut up to the head of navigation, a distance of about 6 miles. The district officer states that to secure this depth and width considerable snagging, dredging, and the cutting off of many sharp points would be necessary. Consideration of the existing physical and commercial conditions leads him to the conclusion that the improvement of this part of the river by the General Government is not justified at the present time. The division engineer recommends a survey to determine the advisability of the improvement.

3. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 11, 1916, concurring in the views of the district officer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of upper Pasquotank River, N. C., from Turners Cut up to the head of navigation at Lebanon Road, or as far as may be practicable, is not deemed advisable at the present time.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 11, 1916.

The Chief of Engineers, United States Army:

1. The following is in review of the district officer's report on preliminary examination of upper Pasquotank River, N. C., "from Turners Cut up to the head of navigation at Lebanon Road, or as far as may be practicable," called for by the act of March 4, 1915.

2. The Pasquotank River is under improvement by the United States up to and including Turners Cut, the entrance to the Dismal Swamp Canal. The portion of the upper Pasquotank now under consideration extends from Turners Cut to the Lebanon Road, a distance of about 6 miles.

3. The channel is tortuous with numerous sharp bends, many snags and overhanging trees, the depths range from 8 feet at Tur-

ners Cut to 2 feet at the head of the reach, and the widths from 180 feet to a minimum of about 15 feet. Two fixed bridges with small openings cross the stream.

4. At ordinary stages only rowboats and small flats can ascend above Staffords Bridge, 3 miles above Turners Cut. Below that point gasoline boats operate. Interested parties estimate the total receipts and shipments, by all means of transportation, in the district affected at about 47,000 tons, of which 17,500 tons consist of logs and piles which can now be handled without undue difficulty. It is claimed that all of the freight would be carried by water if the stream were improved. No statement is given of the amount now handled by water.

5. The improvement desired appears to be a channel 6 feet deep and 40 feet wide. The district officer states that to secure this would require considerable snagging, dredging, and the cutting off of many sharp points. He reports that the stream is neither deep, wide, nor straight enough, nor is the commerce on it sufficiently general or of sufficient importance to justify the improvement by the United States. The division engineer recommends a survey to determine the advisability of the improvement.

6. Interested parties were duly informed of the tenor of the district officer's report and given an opportunity of submitting their views. A communication from Hon. J. H. Small, M. C., indorsed by Hon. F. M. Simmons, United States Senate, favoring a survey and further investigation has been received and given consideration.

7. A careful examination of the data now available discloses that this is a very small, crooked, and much-obstructed stream, having navigable depths of but 2 to 4 feet, minimum widths between banks of 15 to 40 feet, and a prospective navigable length of 6 miles. The amount of commerce now handled on the river is apparently small while the estimates of total receipts and shipments appear large for a thinly populated country such as this seems to be. To fit the river for useful navigation for even small cargo-carrying vessels would require extensive work in removing obstructions and in making cut-offs, and this would apply to any portion of the reach under consideration, although to a less degree in the lower part. It is believed that the improvement of the whole or of any part of the river would be unduly expensive when compared with the resulting benefits to general commerce and navigation, and therefore the board concurs in the opinion of the district officer that it is not advisable for the United States to undertake the work.

8. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other related subjects which could be coordinated with the suggested improvement in such manner as to render the work advisable in the interests of commerce and navigation.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF UPPER PASQUOTANK RIVER, N. C.

WAR DEPARTMENT,
ENGINEER OFFICE, UNITED STATES ARMY,
Norfolk, Va., June 5, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army.
(Through the Division Engineer.)
Subject: Report on preliminary examination of Upper Pasquotank River, N. C.

1. This report is submitted in accordance with section 15 of the river and harbor act approved March 4, 1915, which authorizes an examination and survey of the upper Pasquotank River, N. C., from Turners Cut up to the head of navigation at Lebanon Road, or as far as may be practicable.

2. An examination of the upper Pasquotank River was directed by Congress in the river and harbor act of August 11, 1888. The result of this examination is published in the Report of the Chief of Engineers, 1889, page 1135. In this report the part of the Pasquotank River lying between the ends of Turners Cut was considered as worthy of improvement for steamboat traffic and the upper Pasquotank River as worthy of improvement for barges from the head of Turners Cut to Lebanon Bridge, to the extent of removing snags and clearing, to the natural dimensions of the stream. A small appropriation for this purpose was made by the act of September 19, 1890, but the money was exhausted before the work reached the upper Pasquotank River.

3. The Pasquotank River rises in the swamps of Camden and Pasquotank Counties, N. C., and, after a course of 46 miles, empties into the northeastern end of Albemarle Sound. It is a nontidal, fresh-water stream, narrow and tortuous in its upper portions, and straight and wide in the lower portions. The width at Lebanon Road Bridge, usually considered the head of navigation, is about 20 feet, and the width at its mouth is about 3¼ miles. It carries but little sediment. Its banks are generally only 1 or 2 feet above the water level, and are heavily wooded. In the upper portions of the stream, above Turners Cut, the current has a velocity of about 1½ miles per hour at ordinary stages of the river. After heavy rains greater velocities are found. Below Turners Cut the slope is so slight that the current sometimes runs upstream and at times downstream, depending on the level of the wind tides in Albemarle Sound. The area of the watershed above Turners Cut is about 100 square miles. The location of this river is shown on Coast and Geodetic Survey chart No. 1227 and on the accompanying map.

4. The only town on the Pasquotank River is Elizabeth City, N. C., which has a population of 9,000 and is situated on the right bank of the river, 18 miles above its mouth.

5. The Pasquotank River from its mouth to the head of Turners Cut is the only approach to the Dismal Swamp Canal from the south. This part of the Pasquotank River has been improved by the United States so as to give a 10-foot depth at mean low water, and expenditures are made from time to time for the maintenance of this depth.

6. From its mouth to 1 mile below Elizabeth City, a distance of 17 miles, the stream has an average width of 2 miles and a channel depth of about 11 feet. From the point 1 mile below Elizabeth City to the lower end of Turners Cut, a distance of 14 miles, the average width is 600 feet, and although the stream has some sharp bends in this section, it can be navigated without difficulty by boats drawing 9 feet and less.

7. Turners Cut, an artificial channel, 3½ miles long, 10 feet deep, and 60 feet wide, was constructed originally by the Lake Drummond Canal & Water Co., but is now maintained by the United States in order to avoid 4½ miles of very crooked river.

8. The principal traffic received by the three parts of the river just described is that pasing through the Dismal Swamp Canal, which, during the calendar year 1914, amounted to 474,260 short tons. The portion of the river below Elizabeth City receives, in addition to this, a not inconsiderable traffic with points on the sounds of North Carolina, of which no record is available.

9. The distance, by river, from the upper end of Turners Cut to Lebanon Road is about 6 miles. The channel is tortuous, with numerous sharp bends, which become sharper and more numerous as the river is ascended. The banks on either side are low and swampy, and heavy woods extend to the water's edge for almost its entire length, with many overhanging trees which still further restrict the navigable capacity of the stream. At a few places where the ground is higher than elsewhere, cultivated fields can be seen from the river. Near Turners Cut the average channel depth is about 8 feet at mean low water, diminishing to 2 feet at Lebanon Road. The slope also increases as the river is ascended. The average width of this portion of the river is about 50 feet between banks, with a maximum of 180 feet and a minimum of 15 feet. The channel width is about two-thirds of the width between banks. Snags, stumps, and sunken logs are found in many places. The average fluctuation between high and low water, as observed by the marks on the banks and water stains on the trees, appears to be about 18 inches near Turners Cut and 36 inches near Lebanon Road.

10. The following table gives the principal physical characteristics of each mile of the upper Pasquotank River. Soundings and widths are given at mean low water:

Mile.	Depth (feet).			Width (feet) between banks.			Oscillation, water level (feet).			Current (miles per hour).			Height of banks (feet).		
	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
1	15	4	7	180	40	60	....	....	1.5	....	....	1.0	2	1	1
2	8	4	5	70	30	40	....	....	1.8	....	....	1.0	3	1	1.5
3	7	3	4	60	30	35	....	....	2.1	....	....	1.3	3	1	1.5
4	5	2	3	50	20	30	....	....	2.4	....	....	1.5	4	1	2
5	4	2	3	50	20	30	....	....	2.7	....	....	2.0	4	1	2
6	4	2	2	40	15	20	....	....	3.0	....	....	2.5	4	1	2

11. There are two bridges upon the portion of the river under consideration, both of which are fixed highway bridges. The bridge at Stafford, 3 miles above Turners Cut, has a clear channel span of 12 feet and a clear headroom of 7 feet at mean low water. The bridge at Lebanon Road, the head of navigation, has a clear channel span of 10 feet and a clear headroom of 5 feet at mean low water. Between Turners Cut and Staffords Bridge are six primitive landings, consisting of little more than graded banks, for receiving and discharging freight. There is only one warehouse, and at one point a logging railroad comes out to the river. At Lebanon Road a graded landing and a warehouse have been constructed.

12. At ordinary stages of the river only rowboats and small flatboats can ascend above Staffords Bridge. Below that bridge gasoline boats of 40-foot length and 2 or 3 feet draft carry freight and tow flats 50 feet long, 7 feet wide, and 2 feet in depth, in which freight is also carried. The most important traffic on the stream consists of rafts of logs and piling, which are either poled or towed downstream by small gasoline launches.

13. As there are no railroads near the stream, its improvement would facilitate the marketing of the crops from approximately 38,000 acres of cultivated land, which at present must be hauled over 4 or 5 miles of poor country roads to Turners Cut, to the Dismal Swamp Canal at South Mills, or hauled 14 miles to Elizabeth City for shipment by the Norfolk Southern Railroad, or handled by water in very small boats on the higher stages of the river. Farmers in Gates County, N. C., have an outlet for their products over the Norfolk Southern Railroad, running between Suffolk, Va., and Edenton, N. C., but shipment by this route also involves a long haul over country roads.

14. As a result of the necessity of waiting for favorable stage of water to ship products farmers can not take advantage of a favorable market but must sell whenever they can reach market, whether prices be high or low.

15. In addition to the area of cultivated land referred to above there is a considerable area of timberland adjacent to the stream, the timber from which could more easily be transported upon an improved river, but rafting is possible upon the river even in its present condition.

16. Interested citizens have compiled the following statements, giving the average receipts and shipments of freight of the district for the year 1914, it being claimed that all of the freight listed would be shipped or received by way of the river if it were improved:

Commodity.	Amount in customary units.	Amount in short tons.	Value.
RECEIPTS.			
Agricultural lime	10,000 tons	10,000	$50,000
Brick	2,000,000	4,500	10,000
Guano	8,000 tons	8,000	120,000
Lumber, manufactured	200,000 feet b. m	350	6,000
Machinery, farm	80 tons	80	10,000
Merchandise	100 tons	100	200,000
Wire, fence	250 tons	250	12,500
Total		23,280	408,500
SHIPMENTS.			
Beef, dressed	300,000 pounds	150	30,000
Corn	100,000 bushels	2,800	75,000
Cotton	1,000 bales	250	50,000
Cotton seed	500 tons	500	10,000
Eggs	2,500 crates	81	15,000
Lumber, logs	10,000,000 feet b. m	17,500	300,000
Mutton	25,000 pounds	12	2,000
Oats	25,000 bushels	400	13,000
Pork	250,000 pounds	125	25,000
Peanuts	10,000 bags	500	30,000
Peas	30,000 bushels	900	45,000
Potatoes	10,000 pounds	5	200
Poultry	125,000 pounds	62	18,750
Wheat	15,000 bushels	450	15,000
Total		23,735	628,950

17. All traffic that can be expected upon the improved river is therefore about 47,000 tons annually, the value of which would be about $1,300,000. Of this traffic, however, 17,500 tons valued at $300,000, or about 42 per cent, would be in logs and piles, which can now be rafted and shipped without undue difficulty.

18. Neither the nature nor extent of the improvement desired is indicated in the river and harbor act of March 4, 1915, but interested parties indicate a desire for a depth of about 6 feet and a channel width of about 40 feet. In order to secure this depth and width considerable snagging, dredging, and the cutting off of many sharp points would be necessary.

19. There are no questions of floods, water power, terminals, transfer facilities, or the cooperation of local interests to be considered in connection with this examination.

20. The farmers living near the upper Pasquotank River would undoubtedly be benefited by better transportation facilities. Those living on the river would be most greatly benefited, while those at a greater distance from the river would have their long wagon hauls reduced. In most cases these wagon hauls would be shortened by 4 or 5 miles over roads most of which are often in poor condition.

21. No work has ever been done by the United States above the head of Turners Cut. Maj. W. S. Stanton, Corps of Engineers, in charge of the work in 1892, stated in his report (published in the report of the Chief of Engineers, U. S. Army for 1892, p. 1112) that "it is believed that the river above the Moccasin Track, upper end of Turners Cut, is not worthy of improvement," and recommended that the improvement as contemplated in the project be discontinued. No provision for the improvement of the stream has since been made.

22. Consideration of the physical characteristics and local character of the stream compels the conclusion that it is neither deep, wide, or straight enough, nor is the commerce on it sufficiently general or of sufficient importance to justify the improvement of the stream by the United States. It is therefore recommended that upper Pasquotank River, N. C., be not improved at the present time by the General Government.

J. P. JERVEY,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, SOUTHEAST DIVISION,
June 9, 1915.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The within report of preliminary examination of 6 miles of the Pasquotank River between Turners Cut and Lebanon Road shows that there is a potential commerce amounting to about 30,000 tons of merchandise and 17,500 tons of timber products, the latter of which, however, is more or less adequately served by the river in its present condition.

2. There are many rivers under improvement where the annual tonnage is much less than 30,000 tons, and where the cost of improvement is not unduly large. While the description of the river is not very favorable to an inexpensive improvement, especially one calling for 6 feet in depth, yet it appears to me that in order to determine whether a sufficiently adequate outlet can be obtained at a reasonable cost for the probable tonnage of this river a survey will be necessary.

3. It is therefore recommended that a survey be authorized to determine the extent and character of a suitable improvement and whether the cost of such improvement would be excessive or not.

W. C. LANGFITT,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

LETTER OF HON. JOHN H. SMALL.

HOUSE OF REPRESENTATIVES,
Washington, D. C., June 2, 1916.

GENTLEMEN: Referring to the report on the preliminary examination of upper Pasquotank River, N. C., authorized by the river and harbor act of March 4, 1915. I have carefully read the report of Col. J. P. Jervey, district engineer, who concludes for the reasons stated by him that the improvement of this stream by the United States is not justified. I will not refer in detail to the facts contained in his report, because the board will consider same, but I am impressed that conditions appear showing that this improvement would greatly benefit the territory contiguous to this stream.

I also note the report of Col. Langfitt, division engineer, who recommends that a survey be authorized.

Upon consideration of the whole case, I am constrained to request the Board of Engineers for Rivers and Harbors to concur with the recommendation of Col. Langfitt, and to direct that a survey be made. Some of the reasons which actuate me in submitting this request may be briefly summarized.

1. A detailed survey will disclose further facts; will show the nature of the improvement necessary, and will contain estimates of cost, thereby enabling the district engineer to consider the same more fully and perhaps reach a different conclusion.

2. It is apparent that the people of this agricultural area tributary to this stream are isolated and would be greatly benefited by the improvement. It is only a question of whether existing and prospective traffic upon this stream is sufficient to justify the expenditure for the improvement and the expenditure necessary can not be determined until a survey has been made.

3. It may well transpire that if the district engineer and the board of review should not regard the improvement of this stream as far up as Lebanon Road justifiable, that it will be found that the improvement thereof for a lesser distance up from Turners Cut will be justified. The language of the authorization would permit a favorable recommendation for a part of the distance from Turners Cut to Lebanon Road.

I have a letter from a local committee in which they say that while they are very desirous for the improvement of the stream up to Lebanon Road, yet if this should not meet with favor, they would be exceedingly gratified if the river could be improved as far as the "new road leading to South Mills, or even as far as Pool Landing," which is only about 3 miles above Turners Cut.

I will refer this letter to Senator Simmons, who has had some correspondence with the people in this locality, and ask him to add such comment to the end of this letter as may in his judgment be appropriate.

Very respectfully,

John H. Small, M. C.

The Board of Engineers for Rivers and Harbors.

I join in the foregoing request.

F. M. Simmons.

64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1694.

STEELE AND WASHINGTON BAYOUS AND LAKE WASHINGTON, MISS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON REEXAMINATION OF STEELE AND WASHINGTON BAYOUS AND LAKE WASHINGTON, MISS.

DECEMBER 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

War Department,
Washington, December 7, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated October 30, 1916, together with copy of a report from Maj. H. C. Fiske, dated May 5, 1916, relative to the project for improvement of Steele and Washington Bayous and Lake Washington, Miss., made by him in compliance with the provisions of the act of Congress approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, October 30, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of Steele and Washington Bayous and Lake Washington, Miss.

1. Under authority contained in section 14 of the river and harbor act approved March 4, 1915, there is submitted herewith for trans-

mission to Congress report dated May 5, 1916, by Maj. H. C. Fiske, Corps of Engineers, relative to the project for improvement of Steele and Washington Bayous and Lake Washington, Miss.

2. The existing project for improvement of this locality, adopted by the rivers and harbors act of June 25, 1910, contemplates the removal of obstructions from Glen Allen, on Lake Washington, to the mouth of Steele Bayou, a distance of 60 miles, at an estimated cost of $15,000. There had been expended on this project to June 30, 1915, $11,549.81, and on a former project $12,500, making a total of $24,049.81. The commerce is small, and consists largely of timber products, which can be shipped out at suitable stages without improvement. There has been no noticeable increase of commerce as a result of the improvement, and the amount of general commerce is too small to justify further expenditures. In the opinion of the district officer, the project should be abandoned, and the division engineer and the Board of Engineers for Rivers and Harbors concur in this view.

3. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the abandonment of the existing project for improvement of Steele and Washington Bayous and Lake Washington, Miss.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
August 8, 1916.

The Chief of Engineers, United States Army:

1. The following report on Steele and Washington Bayous and Lake Washington, Miss., is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads:

> And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made.

2. Steele Bayou rises in Swan Lake, Washington County, Miss., flows about 85 miles in a southerly direction and empties into the Yazoo River about 8 miles above its mouth. The Bayou forms an outlet of Lake Washington, with which it is connected by Washington Bayou, 7 miles in length.

3. The existing project, adopted by the river and harbor act of June 25, 1910, contemplates the removal of obstructions from Glen Allen on Lake Washington to the mouth of Steele Bayou, a distance of 60 miles, at an estimated cost of $15,000. There has been expended on this project $11,549.81, and on a former project $12,500, making a total of $24,049.81. At high water there is ample depth for the boats

that use these streams, but at low water the depth is only about 1 foot.

4. During the past six years the commerce varied from a minimum of 1,804 tons to a maximum of 11,831 tons. The average was 7,579 tons, valued at $87,772. During the past two years the average has been 2,600 tons, valued at $15,000. The principal items of commerce are logs and timber products. The district officer estimates that it will cost $2,500 a year to continue the improvement. He states that the territory drained by these streams is well supplied with transportation facilities by the Mississippi River on the west and the Yazoo & Mississippi Valley Railroad on the east, that the development of commerce expected has not taken place, and that while the improvement is a convenience to certain planters and lumber interests, it is not a necessity to anyone. He therefore recommends that the project be abandoned. The division engineer concurs in this recommendation.

5. Interested parties were informed that the question of the abandonment of the project was under consideration, and given an opportunity of submitting statements and arguments to the board. Two communications have been received and given consideration.

6. This waterway lies between the Mississippi River on the west, distant about 6 miles, and the Yazoo & Mississippi Valley Railroad on the east, distant about 5 miles. The locality is therefore well supplied with transportation facilities, as stated by the district officer. The commerce is not large nor of great value, and if timber products, which form the principal tonnage and which can be handled at high stages without improvement, be disregarded, there is little to justify further expenditures. In view of the foregoing, the board concurs with the district officer and the division engineer and recommends legislation authorizing the abandonment of the project.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF STEELE AND WASHINGTON BAYOUS AND LAKE WASHINGTON, MISS.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., May 5, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army.
(Through the Division Engineer.)
Subject: Reexamination of Steele and Washington Bayous and Lake Washington, Miss.

1. In compliance with instructions contained in third indorsement from your office, dated May 29, 1915, report is herewith submitted on the existing project for the improvement of Steele and Washington Bayous and Lake Washington, Miss. These instructions were issued under authority of a paragraph contained in section 14 of the river and harbor act approved March 4, 1915, which reads as follows:

> And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable or in which modifications of the plans or projects should be made.

2. The watershed drained by these streams lies between the Big Sunflower and Mississippi Rivers and includes parts of Washington, Issaquena, and Sharkey Counties, Miss. Steele Bayou rises in Swan Lake, Washington County, Miss., flows about 85 miles in a general southerly direction, and empties into the Yazoo River about 8 miles above its mouth. This river furnishes a navigable approach with a least available depth of 4 feet during the entire year. The bayou forms the outlet of Lake Washington, which also is located in Washington County, Miss., and which is connected with Steele Bayou by Washington Bayou, about 7 miles long. The section included in the project extends from Glen Allen, on Lake Washington, to the mouth of Steele Bayou, a distance of about 60 miles. This waterway is paralleled on the west by the Mississippi River at an average distance of about 6 miles. On the east it is paralleled by the Yazoo & Mississippi Valley Railroad at a distance of about 5 miles.

3. Preliminary examinations of these streams have been made in accordance with law and reports submitted and published as follows: Steele Bayou from its mouth to Swan Lake, Report Chief of Engineers, 1884, page 1360; report was unfavorable. Steele and Washington Bayous and Lake Washington, House Document No. 904, Sixtieth Congress, first session; report was favorable to removing snags, logs, leaning trees, and other obstructions at an estimated cost of $15,000 for about five years' work.

4. The improvement of Steel Bayou was begun by the United States in November, 1884, and the project was extended to include work in Washington Bayou by the act of 1886. Operations in both streams included the removal of snags, logs, stumps, and overhanging trees which obstructed navigation. The total amount expended under this project was $12,500. This work was discontinued in 1896 and no further appropriations were made until 1910, when operations were resumed under a project which proposed the expenditure of $15,000 in a period of five years to remove the same class of obstructions from Steele and Washington Bayous and Lake Washington. This work was in progress between 1910 and 1914, and $11,549.81 was expended in improving these streams. Nothing has been done since January, 1914, as funds were not available for the completion of the project. The total amount expended under both projects was $24,049.81.

5. At high stages which ordinarily occur between January and June there is ample depth of water to permit navigation of the boats which use these streams. Glen Allen on Lake Washington, about 60 miles above mouth of Steele Bayou, is usually considered to be the head of navigation, but during high water the bayous and lake are navigable in fact to the head of Lake Washington, about 70 miles. At high water the maximum draft that can be carried over the shoalest part of the channel under improvement is about 6 feet and at low stages 1 foot. The range between high and low water in the lower part of Steele Bayou is about 35 feet, caused by back water from the Mississippi River, and in this section much greater high-water depths are usual. The lower half of Steele Bayou has been practically cleared of obstructions and navigation in this portion is fairly safe. The remaining portion of the streams has not been thoroughly worked over, and navigation therein is difficult and

dangerous. The bayous are crossed by eight bridges, all of which are provided with draw spans of 40 feet clear opening and have their lowest parts 7 feet above mean high water.

6. Commercial statistics for these streams have been collected for the past six years since work was resumed. During this period the maximum freight carried was reported as 11,831 short tons per annum, the minimum 1,804, and the average 7,579. The maximum yearly value of this freight was estimated to be $160,525, the minimum $7,219, and the average $87,772. It is believed that the great disparity in annual maximum and minimum was due to failure of the larger shippers to make correct reports, although the prevailing water stages also probably affected the traffic. The improvement of these streams has reduced freight rates about 50 per cent, but the Mississippi River is also so near the railroads affected that when this section is developed to the point of having ordinary country roads the influence of the Mississippi alone should be enough to accomplish this reduction. The country around Lake Washington and through which the bayous flow has a rich alluvial soil, and the upper part is well settled and produces large crops. The land along the lower end of Steele Bayou, however, is subject to overflow by backwater from the Mississippi River, which considerably injures its farming value.

7. There are no terminal facilities under public control on these streams, no water-power possibilities are involved in their improvement, and no questions of land reclamation, protection from floods, or other special features involving cooperation by local interests have been encountered which require consideration at the present time.

8. A blue print[1] of a small sketch map of these streams is sent herewith. This map was prepared to accompany the annual report of this district for the fiscal year ending June 30, 1913. The tracing of the map was sent to the Office of Chief of Engineers with letter from this office dated July 29, 1913. The Mississippi River, which is not shown on the tracing, has been added to the blue print.

9. The territory drained by these streams is well supplied with transportation facilities by the Mississippi River on the west and the Yazoo & Mississippi Valley Railroad on the east. These bayous as navigable streams are a convenience to certain planters and lumber interests, but they are not a necessity to anyone. The development of commerce which was expected in 1910 has not materialized. I therefore recommend that this project be abandoned.

HAROLD C. FISKE,
Major, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, WESTERN DIVISION,
St. Louis, Mo., May 10, 1916.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded.

2. As the bayous parallel the Mississippi River at an average distance of 6 miles and the development of commerce anticipated by

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[1] Not printed.

their improvement has not materialized, the recommendation of the district officer that the project be abandoned is concurred in.

C. McD. Townsend,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

LETTER OF LEE RICHARDSON & CO.

Vicksburg, Miss., *June 16, 1916.*

Gentlemen: Your letter of June 6, wherein you contemplate abandoning the work on Steele Bayou was a great surprise to us, as well as a disappointment. We don't know much about Washington Bayou and Lake Washington, but we do know that for 60 miles up Steele Bayou from its mouth it would pay handsomely considering the small amount of money it would take to clear it up. It is a very important stream to that portion of the country, and it could be put in shape for such an insignificant amount that it looks like a shame not to do so. For about 60 miles from its mouth up it is very extensively used.

Sincerely,

Lee Richardson & Co.,
Lee Richardson.

The Board of Engineers for Rivers and Harbors.

LETTER OF HOUSTON BROS.

Vicksburg, Miss., *June 8, 1916.*

Gentlemen: We have your circular inquiry of June 6 relative to the proposed abandonment of the plans for the improvement of Steele and Washington Bayous and Lake Washington in Mississippi. We note that we are given this opportunity of presenting statements and arguments bearing on the advisability of the United States Government continuing this improvement. We therefore respectfully submit the following reasons why the improvements on Steele Bayou should not be entirely abandoned for the present:

1. Steele Bayou, especially the lower end, offers the only mode of transportation during high water into that territory lying between the Yazoo & Mississippi Valley Railroad and the Mississippi River. The low flat country between the east bank of the bayou and the Yazoo & Mississippi Valley Railroad is often covered with water during our overflow periods. The same condition exists at numerous places on the west side between the bayou and the Mississippi River. Our past experience has been, particularly during the years 1912, 1913, and 1916, that Steele Bayou offers the only means of transportation to and from that territory.

2. That, regardless of reports to the contrary, there is a considerable amount of navigation in Steele Bayou, especially in Warren, Issaquena, and Sharkey Counties. Cotton, cotton seed, lumber, grain, cattle, and general plantation, sawmill, and commissary supplies are brought up and down the bayou from this territory. The bulk of the freight is handled in small barges, being towed by gasoline boats or small steamboats. Our own company often find it necessary to take our supplies up Steele Bayou, using our steamboats, which run from 75 to 100 tons.

3. If the Federal Government discontinues the maintenance or further improvement of Steele Bayou it will mean that some few of the adjoining property owners will assume that the stream is no longer to be considered navigable, and will therefore build bridges and docks; construct telephone lines and do other things which will interfere with navigation. It is only through respect for the Federal Government that we, who use the bayou as a mode of transportation, have been able to keep obstacles from being placed in the way of a free use of that waterway.

4. If the Federal Government neglects to continue to maintain and improve Steele Bayou, at least to a reasonable extent, so that navigation will be possible, the bayou will soon become obstructed with fallen timber, snags, and tree

growth. The individuals who use this water course can not afford to go to the expense of even occasionally cleaning out the bayou. They have not in the past been willing to cooperate to a sufficient extent to defray the expenses of such work. The rapid growing cottonwood, willow, and other varieties of trees and shrubbery found in this country will, in the course of a very short time, make navigation impossible in Steele Bayou unless the Government or some one in authority will see to it that these obstructions are cut down or removed at proper intervals. The Government can do this work without interference by the adjoining property owners. If an individual or a group of individuals should attempt to cut down trees along the water course there would be considerable antagonism and litigation on the part of arbitrary property owners along the bayou.

5. It is a well-known fact that some of the richest soil and best property in the lower Delta country is found along the banks of Steele Bayou. It is only a matter of time until the better land along the bayou will be opened up and extensively developed in the same manner that land bordering other water courses in this part of the State have been improved. This being the case, it would seem to us, who are interested in the development of this lower Delta country, that all of the encouragement possible should be given by the Federal Government to the development of the land bordering Steele Bayou. It is our opinion that if the Federal Government abandons the maintenance and improvement of Steele Bayou it will do much to discourage development in that territory.

Our company would not care to go on record as advocating expensive improvements on Steele Bayou at the present time. However, we do favor and strongly recommend the maintenance of the bayou in at least its present condition. We would also recommend that further improvements be made from time to time, said expenditures to be governed by the increased volume of commerce that may develop on Steele Bayou in the future. We would be very glad to furnish your commission with any information, statistics, etc., that you might require in making a decision as to whether or not it is advisable to abandon your present policy of maintaining and improving Steele Bayou.

We further sincerely hope that you will continue your interest in this water course in the future as you have during recent years.

Respectfully, yours,

HOUSTON BROS.,
Per GEO. I. HOUSTON, Jr.

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

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64TH CONGRESS, } HOUSE OF REPRESENTATIVES. { DOCUMENT
2d Session. } { No. 1695.

OHIO RIVER.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON REEXAMINATION OF THE PROJECT FOR IMPROVEMENT OF THE OHIO RIVER WITH REFERENCE TO CHANGES IN TYPE, NUMBER, AND LOCATIONS OF THE LOCKS AND DAMS CONSTRUCTED AND PROPOSED.

DECEMBER 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

WAR DEPARTMENT,
Washington, December 7, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated September 6, 1916, together with copy of a report from the Ohio River Board dated April 29, 1916, relative to the project for improvement of the Ohio River, made by it in compliance with the provisions of section 14 of the river and harbor act approved March 4, 1915.

Very respectfully,

NEWTON D. BAKER,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, September 6, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of Ohio River.

1. Under authority of section 14 of the river and harbor act approved March 4, 1915, there is submitted herewith for transmission to Congress report dated April 29, 1916, by the Ohio River Board, relative to the project for improvement of the Ohio River.

2. The existing project for the slackwater improvement of the Ohio River, adopted by the river and harbor act of June 25, 1910, contemplates the improvement of the entire river to a depth of 9 feet by the construction of 54 locks and movable dams and the widening of the Louisville & Portland Canal, in accordance with the report submitted in House Document No. 492, Sixtieth Congress, first session, or such modification thereof as in the discretion of the Secretary of War may be advisable. Under the authority granted the Secretary of War, the project has been modified to provide for the widening of the Louisville & Portland Canal and Lock from 170 feet to 200 feet and from 85 feet to 110 feet, respectively, and for the omission of Lock and Dam No. 42, reducing the total number to 53. It has been found that in the upper river, where the run-off is more rapid than below, fixed dams would have some important advantages over movable dams, particularly in maintaining permanent pools in which tows may be made up conveniently and in affording better conditions for the establishment of industrial plants along the banks. Dams Nos. 1 and 2 were constructed many years ago and were originally designed for a depth of 6 feet, being subsequently modified for a depth of 9 feet. They are now in poor condition and will require reconstruction in the near future. In the opinion of the Ohio River Board it is advisable to substitute for these two dams one fixed dam located at or near Emsworth, and it recommends that the Secretary of War be given authority, if the same is not already possessed, to cause fixed dams to be built on the Ohio River wherever such fixed dams would be more advantageous than movable dams. Lock No. 48 is the lowermost lock on which construction has been begun. In view of the possibility that the project depth below this lock may be made available by dredging at reasonable cost, the Ohio River Board recommends that work under the project below this lock be held in abeyance for the present. The Board of Engineers for Rivers and Harbors is in general accord with the views of the Ohio River Board.

3. After due consideration of the above-mentioned reports, I concur in general with the views of the Ohio River Board and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the construction of a fixed dam at or near Emsworth, Pa., in place of the existing movable Dams Nos. 1 and 2, and authorizing the Secretary of War to substitute fixed for movable dams wherever in his opinion they may be desirable, and to substitute open river improvement for movable dams below No. 48, if this should appear to be advantageous.

W. M. BLACK,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Fifth indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
July 25, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following report on the Ohio River is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads:

And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made.

2. The present project for the improvement of the Ohio River, adopted by the river and harbor act of June 25, 1910, contemplates the improvement of the entire river to a depth of 9 feet by the construction of 54 locks and movable dams and the widening of the Louisville & Portland Canal, or such modification thereof as in the discretion of the Secretary of War may be advisable. Under the authority granted the Secretary of War, the Louisville & Portland Canal and lock have been widened from 170 feet to 200 feet and from 85 feet to 110 feet, respectively, and Lock and Dam No. 42 have been omitted by adjusting the lifts of Nos. 43, 44, 45, and 46, thus reducing the total number to 53.

3. Fifteen locks and dams, including those in existence when the present project was adopted and which have been altered to give a depth of 9 feet, have been completed, 19 are partially constructed, and 19 have not been begun. Experience has shown, as explained in the accompanying report of the Ohio River Board, that in the upper part of the river fixed dams would have many advantages over movable dams, and on account of the greater lift possible with a fixed dam one structure of this type could be substituted for Nos. 1 and 2 of the existing system. These latter are in a bad state of repair and will require reconstruction in the near future unless they are replaced by a fixed dam as is recommended by the Ohio River Board.

4. Lock and Dam No. 48, 804.1 miles below Pittsburgh, is the lowermost one upon which construction has begun. Consideration is given by the Ohio River Board to the question of maintaining the desired channel depth below this dam by dredging instead of by the completion of the slackwater system. Experience indicates that the estimates for the locks and dams on the lower river are too low; also that the unit cost of dredging is higher than on the Mississippi River and that apparently there is not a sufficient flow of water in the Ohio at its lowest stage between No. 48 and the mouth of the Tennessee River to maintain a dredged channel of project depth. Below this tributary conditions are more favorable for maintaining an open channel, and it appears probable that the 9-foot depth can be successfully and economically maintained by dredging below the mouth of the Tennessee. Whether dredging or locks and dams will be the better between No. 48 and the mouth of the Tennessee is a question which can be determined only by further experience and it is proposed by the Ohio River Board to conduct such dredging operations below No. 48 during the next few seasons as will permit a determination of this question, the work to be carried on under the existing project for open-channel improvement.

5. In conclusion the Ohio River Board recommends:

(a) That the Secretary of War be given authority, if the same is not already possessed, to cause fixed dams to be built in the Ohio River wherever such fixed dams would be more advantageous than movable dams, and that such authority be secured by the first bill in Congress to which its enactment would be germane.

(b) That a fixed dam at or near Emsworth, Pa., be built at an early date to take the place of existing Dams 1 and 2.

(c) That the question of number and location of other fixed dams be left open at present pending information gained by experience with the first fixed dam.

(*d*) That the question of the construction of dams below No. 48 or the maintenance of the channel in this part of the river by dredging be held in abeyance and allowed to await decision from the data obtained by the time that the matter of construction of these dams in serial order would arise.

6. The Board of Engineers for Rivers and Harbors is in general accord with the views of the Ohio River Board. It therefore recommends the following modifications of the existing project for the improvement of Ohio River; that a fixed dam be authorized at or near Emsworth, Pa., in place of the existing movable Dams Nos. 1 and 2; that the Secretary of War be given authority to substitute fixed for movable dams wherever in his opinion they may be desirable and to substitute open-river improvement for movable dams below No. 48 should this appear to be advantageous.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF OHIO RIVER.

WAR DEPARTMENT,
OFFICE OF THE DIVISION ENGINEER,
CENTRAL DIVISION,
Cincinnati, Ohio, April 29, 1916.

From: The Senior Member, Ohio River Board.
To: The Chief of Engineers, United States Army.
Subject: Review of project for improvement of Ohio River.

1. The Ohio River Board has to submit the following reply to the letter of April 28, 1915, from the Board of Engineers for Rivers and Harbors, recommending a review of the project for the improvement of the Ohio River, which letter was as follows:

> Referring to reports of district officers on the Ohio River concerning desirable modifications in the existing projects for that river, the board recommends that the Ohio River Board be requested to submit a general review of the entire canalization plan, with any recommendations it may deem advisable regarding changes in the type, number, and locations of the locks and dams constructed and proposed, and including consideration of the most advantageous type of improvement below Dam 48, and the possibility of operating a long series of Chanoine movable dams so as not to interfere with navigation under the conditions of flow and ice that obtain on this river.

2. The present project for the improvement of the Ohio River, which is to provide a navigable depth of 9 feet from Pittsburgh, Pa., to the Mississippi River at Cairo, Ill., in accordance with the report submitted in House Document No. 492, Sixtieth Congress, first session, or such modification thereof as in the discretion of the Secretary of War may be advisable, was adopted by Congress in the river and harbor act approved June 25, 1910. The report named recommended the construction of 54 locks and movable dams between Pittsburgh and Cairo and the widening of the Louisville & Portland Canal around the falls of the Ohio at Louisville, Ky.

3. The modifications which have been made to date by the Secretary of War under the authority granted him are as follows:

(*a*) An additional increase in width to be given to the Louisville & Portland Canal from 170 feet to 200 feet and to the new lock from 85 feet to 110 feet to make the lock f similar dimensions to others upon the river, to enable the canal to accommodate the resulting sized tows which would probably use the lock. Approved March 2, 1911.

(b) The omission of Lock and Dam No. 42 by adjusting the lifts of Dams Nos. 43, 44, 45, and 46, thus reducing to 53 the number of locks and dams to be built under the project. Approved September 2, 1913.

4. Work under the project is as indicated in the following table:

Lock and dam No.	Distance below Pittsburgh.	Per cent complete.	Estimated cost (H. Doc. 492, 60th Cong., 1st sess.).	Actual cost.	Appropriated and allotted.
	Miles.				
1	4.7	100	[1] $940,000.00	$973,689.87	...
2	9.0	100	[2] 750,000.00	977,244.37	...
3	10.9	100	[2] 750,000.00	1,164,175.78	...
4	18.6	100	[2] 750,000.00	1.086,429.81	...
5	23.9	100	[2] 750,000.00	1,086,664.65	...
6	28.8	100	[1] 1,075,000.00	1,123,720.15	...
7	36.9	100	1,117,800.00	[3] 1,054,889.70	...
8	46.1	100	1,206.595.00	1,167,478.94	...
9	55.6	100	1,100,000.00	[3] 1,168,362.13	...
10	65.7	98	1,240,000.00	...	$1,140,000.00
11	76.3	100	1,153,093.00	1,162,223.00	...
12	87.0	90	1,320,000.00	...	1,183,000.00
13	95.8	100	1,110,000.00	1,220,980.00	...
14	113.8	73	1,100,000.00	...	1,134,326.26
15	128.9	96	1,200,000.00	...	1,155,038.24
16	146.4	80	1,200,000.00	...	1,223,400.00
17	167.4	75	1.240,000.00	...	1,317,500.00
18	179.3	100	832,000.00	912,978.00	...
19	191.4	94	850,000.00	...	1,240,000.00
20	201.7	88	1,280,000.00	...	952,000.00
21	213.8	19	1,200,000.00	...	415,000.00
22	220.1	21	1,200,000.00	...	450,000.00
23	230.6	...	1,200,000.00	...	2,000.00
24	242.0	34	1,200,000.00	...	896,000.00
25	260.0	...	1,150,000.00	...	2,000.00
26	278.0	100	1,100,000.00	1,228,847.72	...
27	300.3	...	1,240,000.00	...	2,000.00
28	310.9	100	1,240,000.00	1,017,916.42	...
29	319.4	89	1,240,000.00	...	1,005,000.00
30	338.9	...	1,280,000.00	...	...
31	358.4	40	1,320,000.00	...	810,000.00
32	383.7	...	1,380,000.00	...	...
33	404.0	21	1,240,000.00	...	1,087,000.00
34	432.8	...	1,440,000.00	...	...
35	449.7	54	1,440,000.00	...	1,247,100.00
36	458.4	...	1,440,000.00	...	...
37	481.3	100	1,050,000.00	1,299,425.60	...
38	501.3	...	1,240,000.00	...	...
39	529.6	34	1,450,000.00	...	867,526.40
40	553.6	...	1,620,000.00	...	...
L. & P. Canal.					
41	604.0	71	1,835,000.00	...	2,290,000.00
42[4]	...	...	1,360,000.00	...	...
43	630.2	60	1,480,000.00	...	1,352,000.00
44	660.3	...	1,280,000.00	...	...
45	699.7	...	1,580,000.00	...	...
46	748.5	...	1,720,000.00	...	...
47	771.3	...	1,720,000.00	...	...
48	804.1	44	1,840,000.00	...	2,004,000.00
49	830.5	...	1,640,000.00	...	...
50	850.6	...	1.480,000.00	...	...
51	878.0	...	1,584,000.00	...	...
52	913.2	...	2,248,000.00	...	...
53	946.0	...	2,800,000.00	...	...
54	962.4	...	2,260,000.00	...	...
Surveys	...	...	...	...	579,000.00
Contingencies	...	...	...	...	62,000.00

[1] Original estimate.
[2] Estimate given in H. Doc. 204, 54th Cong., 1st sess.
[3] Exclusive of cost of dredging approaches to locks, not yet done.
[4] Eliminated.

5. *Substitution of fixed dams for movable dams.*—The establishment of the various dams in the vicinity of Pittsburgh has caused a change in the methods of assembling and sending out the coal fleets. Dam

No. 1, formerly known as Davis Island Dam, was originally built for the purpose of providing a pool below the mouth of the Monongahela River which would permit the assembling of the coal boats and the formation of tows of practicable size ready for the downstream run when a "coal-boat rise" occurred in the river. On account of the necessity for passing through the small locks, coal tows could not be made up in the Monongahela, and until the Davis Island Dam pool was provided in the Ohio there was no way of assembling these tows until a stage of water occurred sufficient to permit the maneuvering of the fleets. The result was that a short rise would run off before the fleets could be started downstream, sometimes leaving the coal boats in very undesirable positions in addition to having entirely lost the opportunity of getting down river until another rise of sufficient magnitude occurred. Following the construction of Dams 2, 3, 4, etc., the coal men and vessel interests have found it advantageous at times to assemble their tows farther downstream than formerly, for this could be done without any appreciable increase of cost, owing to the fact that the vessels were always in commission and operating charges continuous. The distance downstream thus secured was that much gained in the fleet's run, and a further advantage was that much of the former congestion in pool No. 1 was avoided. As a result of this experience the sentiment has been growing among those interested in this traffic that the establishment of permanent pools by fixed dams upon this portion of the river would be a gain to the commerce originating in the vicinity of Pittsburgh. The construction of permanent, or fixed, dams would also permit the establishment of factories and large industrial plants requiring great quantities of water along the upper Ohio, a thing that is now not always advantageous owing to the uncertain supply during the winter when the dams are down continuously and the difficulties of providing satisfactory intakes. The banks of the Monongahela, which has fixed dams, are lined with such industrial establishments and it is claimed that one plant on this river constantly takes out and returns to the pool on which it is located more water than there is running in the stream at its lowest stage. Many of these concerns, or others of similar character, would like to locate upon the Ohio if it could only afford them permanent pools for the use of water and a corresponding facility for procuring their coal by boat. Permanent pools would also permit the use of the river for receipt and shipment of freight at these plants better than is possible with a series of movable dams.

6. For these reasons the original opposition of the navigation interests to fixed dams has apparently entirely disappeared, and at a public hearing before the Ohio River Board at Pittsburgh on January 29, 1915, the expressions of opinion were to the effect that fixed dams on the extreme upper Ohio would be better than movable dams. The apprehension of the citizens of the locality that fixed dams would increase the flood heights in the Ohio, which apprehension would have been very influential against any attempts to build dams of this kind when the earliest movable structures were established has, it is believed, vanished. They have before them the experience of more than 40 years upon the Monongahela which has established the fact beyond controversy, that while fixed dams of the heights

there used, and which are practically the same as would be used upon the Ohio, may increase the height of freshets or moderate rises in their immediate vicinity, their effect upon extreme flood heights is practically negligible, and that no unusual damage to property from excessive floods due to their construction need be apprehended. Some property a short distance above each fixed dam would be subject to more frequent submersion than at present, but the extent of this overflow and the resulting damage can be estimated quite closely in advance and given proper consideration before work at any locality is commenced or before the construction of any particular dam is authorized.

7. There is some difficulty in the extreme upper river, greatest at Dams Nos. 1 and 2 and diminishing progressively downstream, in maintaining a 9-foot depth at all times, for owing to the steepness of the slope of the river bed the pools are so short and the velocity of the current so great that on the approach of a freshet the dams have to be lowered at an 8-foot open-river stage on account of the rapid accumulation of water above the dam before the operation would otherwise be completed, rendering the maneuvering of the wickets difficult. If the lock force waited until the water had risen to 9 feet open-river stage before starting to lower the dam, it would often be too deep before all the wickets were lowered to permit the work to be finished. For the same reasons these dams can not ordinarily be raised until the river has fallen to a 7-foot open-river stage. This difficulty can hardly be said to be of much importance below Dam 6, but above No. 6 there is apt to be a deficiency in depth just below a recently raised dam on account of the water in the lower pool running off while the upper pool is being filled. The more nearly simultaneously the dams can be raised the less noticeable is this trouble. Movable dams can not safely be allowed to stand or be maneuvered when there is thick ice in the river. The wickets and their supports can not be made strong enough to withstand the impact and jamming of floating ice without making them too heavy and unwieldy for practicable and economical operation. It is dangerous to allow the dam to remain up until its pool has frozen over, for it is then impossible to lower the dam, and with it the surface of the water by several feet, without imparting motion to the entire field of ice which, if once started, could easily carry away a large portion of the structure. This risk is not justified, and the dams are therefore lowered when freezing weather begins, usually in December, and remain down until low water in the spring again requires their use. Precautions against the injurious effects of ice always have to be taken during the winter months, although the actual effects vary greatly from year to year and may, as during the past winter, be practically nil. The ice effect in most winters disappears between Cincinnati and Louisville, and ice harbors established for the protection of vessels have not been built by the United States below Maysville, Ky., although some have been built by private interests at Cincinnati. Navigation is regarded as remaining open on the Ohio all the year, and the Lighthouse Bureau maintains its service throughout the 12 months.

8. Fixed dams are not affected by ice but on the contrary are apt to exercise a desirable effect on the larger masses by causing them to

break in their passage. A fixed dam can be given a slightly greater lift at this part of the river without causing undue flooding than is possible to give to a movable dam owing to the limits imposed by the practicable length of wickets, and this increased height will permit a reduction of the number of dams necessary to properly slackwater a definite length of river. This diminution in number of dams will in turn have a corresponding effect upon maintenance charges and annual cost of operation. It is estimated that the annual cost of operating a fixed dam and lock will be at least $5,000 less than that of a movable dam and lock. Considerations so far presented have assumed that the flow of the upper Ohio will be in the future as in the past, that future floods will be as frequent and of the same magnitude as they have been heretofore; but if the various proposals which have been advanced for the construction of reservoir systems in the Allegheny and Monongahela River basins by private power companies, by the Lake Erie & Ohio River Ship Canal Board, the Pittsburgh Flood Commission, and others, should be wholly or even partially realized, they will probably improve conditions which would not be made worse by the change from movable to fixed dams.

9. The advantage of the fixed dam and permanent pool over the movable dam and intermittent pool in the matter of fuel supply is very clearly set forth in a letter from one large manufacturing concern having plants in both situations, in which it states as follows:

> Our experience, extending over many years, in the transportation of large quantities of coal from our mines located in the fourth and fifth pools of the Monongahela River by way of that river to our Pittsburgh works, and also from the same mines to our Aliquippa works, located on the Ohio River at the fourth pool, enables us to show the contrast between the effect upon this transportation business where the dams controlling the river navigation are of the fixed type, as in the case of the Monongahela River, and where the dams are of the movable type, as in the case of the Ohio River below Pittsburgh. When our Pittsburgh works are running at full capacity, they require about 9,500 tons of coal per day, and with this large requirement, it is necessary for emergency purposes to keep only about 25,000 tons on the ground in stock, as the river navigation is so little interrupted that we can count practically upon continuous service between the works and the coal mines, whereas at the Aliquippa works on the Ohio River at the fourth pool, where the total coal requirements when operating at full capacity are a little less than 4,000 tons daily, we have had during the past year in stock on the ground 160,000 tons of coal, which, owing to the interruptions to navigation on the Ohio River by reason of the movable dams, was entirely inadequate to carry us through such periods, and we were forced to go to the railroad for the transportation of our coal.
>
> We are now preparing, at great expense, to stock 250,000 tons or more to carry us through the coming winter. This will require a space 300 feet wide by 1,087 feet long, the most of which should be used for buildings for manufacturing purposes, and the greater portion of this valuable ground would be used, if only the same proportional amount of coal for emergency work need be stocked as is done at the Pittsburgh works.
>
> We have had under consideration many times the shipment by river of various kinds of finished and semifinished products of our works between the Pittsburgh works and the Aliquippa works, and also from both of these works to down-river points, but the uncertainties due to the interruptions to navigation on the Ohio River have been so frequent—as for example, during this last year, there were 13 periods covering a total of over 125 days—that we have had to abandon such plans for the time being.

10. It is believed that the Secretary of War should be given authority to direct the construction of such fixed dams as may be regarded as advisable, if it be held that he does not now possess such authority under the act of Congress approved June 25, 1910, and that a fixed dam should be built at the upper end of the system,

probably near Emsworth, Pa., to replace the present Nos. 1 and 2, at as early a date as funds can be secured. The fact that Dams 1 and 2 are so badly out of repair that their maintenance costs are becoming excessive and their reconstruction in the near future will be imperative unless they can be replaced by the fixed dam are the reasons why early action in this instance is advisable. It is probable that other fixed dams will eventually be found advantageous below that proposed near Emsworth but it is not regarded as economical or advantageous to make such a change at present. The question of number, lift, and location of fixed dams can undoubtedly receive a better answer after the experience gained with the first fixed dam than it is possible to give at this time.[1]

11. *Maintenance of channel below Dam 48 by dredging or by dams.*—This subject received careful consideration by the special board, whose report is published in House Document No. 492, Sixtieth Congress, first session, and that board came to the conclusion that the building of the locks and dams would be the more economical. Since that report was submitted, the experience gained by actual construction of locks and dams upon the lower Ohio leads to the conclusion that the board's estimates of cost for building these structures in this part of the river are probably too low, as the work here is more expensive than on the upper waters, where the only cost data existed at the time their report was rendered. Recent improvements in dredges of large type have materially lowered the cost of the removal of material obstructive to a channel in the lower Ohio, but dredging in this section has encountered difficulty in disposing of the excavated material, resulting in a higher unit cost than on the Mississippi, and has also developed the fact that apparently there is not a sufficient flow of water in the Ohio at its lowest stages between Dam 48 and the mouths of the Cumberland and Tennessee Rivers to keep open a dredged channel, and that unless a dredge can make at one cut a channel of the desired width there is a liability of its deterioration by silting before completion. Below the point of entrance of the two large tributaries named, conditions are more favorable for maintaining an open channel. On the other hand, the records show that the periods during which a depth of less than 9 feet occurs in the portion of the river below Dam 48 are very variable. During the year 1915 depths of less than 9 feet occurred twice, but on each occasion the duration was so short that before dredges could be started to the locality the river had risen sufficiently to again provide a 9-foot channel through this stretch. In the past 10 years the number of days on which less than 9 feet was found in the channel between Dam 48 and the mouth of the river varied between 30 in 1907 and 183 in 1908. March and April were the only months which did not experience a deficient channel for

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[1] The fact that Lock and Dam No. 1 was built more than 30 years ago with natural cement, owing to the fact that American manufacturers were not yet able to produce good Portland cement and the cost of foreign Portland cement was prohibitive, and the further fact that Lock and Dam No. 2 was built before the adoption of the present project and intended to create only a 6-foot channel but afterwards modified to provide for a 9-foot depth, and therefore required to undergo strains and conditions not contemplated when the structure was built, account for the condition of these two dams. It is not believed that the construction conditions indicated above will apply below the point where it is considered that fixed dams will ultimately be found desirable and advisable. The district officer at Pittsburgh informs the board that, owing to the change of channel depth from 6 to 9 feet, the navigable pass of Dam No. 2 is about 3 feet higher than it ought to be to provide a 9-foot channel, and that recently a barge drawing 8 feet ran onto this sill with such force as to become fast, and that a tow in attempting to pass the stranded barge was broken up and the towboat grounded on the sill. This condition should be remedied as promptly as possible.

even a single day during these years. The periods of shallow water occurring before June were all of less than a week's duration, but beginning with this month the deficiency of water was liable to be more or less continuous without following any rule; in 1908 it was continuous from August 12 to the end of the year and almost so after June 20; in 1912 the deficiency occurred almost entirely during June, July, and August, without a day of deficient depth after September 5. As the flow of the Tennessee is as large as that of the Ohio, conditions are better between Paducah, at the junction of the two rivers, and Cairo than above indicated between No. 48 and Paducah. During the years from 1905 to 1915 the number of days of deficient depth below the mouth of the Tennessee varied from 1 in 1906 to 111 in 1908, the average being 63.6 days below Paducah to 106.5 days above that point. On many of the days indicated the deficiency was very slight or nominal and a channel could have been maintained by a dredge without difficulty. From present information it appears probable that a 9-foot channel can be successfully and economically maintained by dredging below the mouth of the Tennessee River. Whether dredging or locks and dams will be the better between the Tennessee and No. 48 is, however, a question which can be decided only by experience, and it is regarded as advisable to conduct such dredging operations below No. 48 during the next few seasons as will permit the facts to be ascertained and a decision to be made. The Secretary of War should be authorized to substitute dredging for the construction of locks and dams where, in his opinion, it is advisable to do so.

12. With regard to any other "changes in the type, number, and location of the locks and dams constructed and proposed," the board is of the opinion that while other changes may become desirable, there are none of such character as to warrant a recommendation at this date or to be beyond the authority of the Secretary of War as it now exists or is here proposed. Experiments are now being made with a new kind of wicket, which may cause modifications in the movable dams, but it is a little early to state what the results will be, much less to make any recommendations concerning changes in the type of movable dams, which changes, if any, will be matters of construction detail and will not affect the project. No reasons affecting the number of dams as now determined are apparent except those relating to the construction of a fixed dam to take the place of present Nos. 1 and 2, mentioned above, the omission of Dam 40, which is a construction question within the existing power of the Secretary of War, and those concerning the omission of the dams below No. 48, described previously. The locations of those not yet built or commenced are regarded as approximately determined only, and subject to such slight changes in site as borings or other tests of foundation conditions may indicate as advisable. The data upon this point are not yet available.

13. In reply to the question as to "the possibility of operating a long series of Chanoine movable dams so as not to interfere with navigation under the conditions of flow and ice that obtain in this river," the Ohio River Board can best answer this question by pointing to the record of the dams already built; they are in that portion of the river where ice is most likely to form and is the heaviest

when it does occur, and where conditions of operation are more difficult than upon the other portions of the river, as explained in paragraph 7. If they can be successfully operated at the upper end of the river, there is every reason to believe that they can be as successfully worked and probably more readily managed upon the middle and lower river. The question as worded implies a doubt as to whether those already constructed have not been an interference with navigation. Had they produced any such effect, the vessel men and navigation interests and coal operators generally would hardly be as unanimous in their desire for the construction of more dams and so insistent for that construction at as early a date as possible. No facts have been presented to any members of the board indicating that the dams already built have acted otherwise than as an aid to navigation and commerce, nor have any adverse reports been received from those most interested in their operation and best qualified to know the results so far attained. The board would further invite attention to the fact that there is every reason to believe that improvements in mechanism and methods of operation will be devised whereby there will be an increase in ease and certainty of operation beyond that now existing.

14. There are no questions of land reclamation involved in the project, and at the only site where water power could be considered possible—that is, at Dam No. 41—the board believes that the construction of a power plant is not warranted under present conditions of cheap coal supply and the impossibility of an all-year continuous operation.

15. In conclusion the board recommends:

(*a*) That the Secretary of War be given authority, if the same is not already possessed, to cause fixed dams to be built in the Ohio River wherever such fixed dams would be more advantageous than movable dams, and that such authority be secured by the first bill in Congress to which its enactment would be germane.

(*b*) That a fixed dam at or near Emsworth, Pa., be built at an early date to take the place of existing Dams 1 and 2.

(*c*) That the question of number and location of other fixed dams be left open at present pending information gained by experience with the first fixed dam.

(*d*) That the question of the construction of the dams below No. 48 or the maintenance of the channel in this part of the river by dredging be held in abeyance and allowed to await decision from the data obtained by the time that the matter of construction of these dams in serial order would arise, and submits the following statement: That while it is not known exactly how many dams are to be considered as constituting a "long series," the fact that a quarter of the total number are now in serial operation with several more at intervals, not only without any interference with navigation but with acknowledged benefit and assistance thereto, the board sees no reason to doubt the success of the work and believes it advisable to continue along the same general lines as have been so far followed.

LANSING H. BEACH,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

64th Congress, 2d Session. } HOUSE OF REPRESENTATIVES. { Document No. 1696.

BEAR CREEK, MISS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON REEXAMINATION OF BEAR CREEK, MISS.

December 7, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

War Department,
Washington, December 7, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith, a letter from the Chief of Engineers, United States Army, dated October 30, 1916, together with copy of a report from Maj. H. C. Fiske, Corps of Engineers, dated May 2, 1916, relative to the project for improvement of Bear Creek, Miss., made by him in compliance with the provisions of the act of Congress approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, October 30, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of Bear Creek, Miss.

1. Under authority contained in section 14 of the river and harbor act approved March 4, 1915, there is submitted herewith for trans-

mission to Congress report dated May 2, 1916, by Maj. H. C. Fiske, Corps of Engineers, relative to the project for improvement of Bear Creek, Miss.

2. Bear Creek has a length of about 90 miles and empties into the Yazoo River about 6 miles above Belzoni, Miss. The navigable portion is confined to the lower 25 miles, consisting of 13 miles of lakes and 12 miles of connecting waterway. The existing and only project, adopted by the river and harbor act of June 25, 1910, contemplates the removal of obstructions from the waterway connecting Threemile, Sixmile, Fourmile, and Wasp Lakes, at an estimated cost of $3,000 the first year and $2,500 for a repetition of the work three years later, the question of subsequent maintenance to be decided after the above work has been accomplished and its effect upon commerce noted. The total expenditures to June 30, 1915, amounted to $5,432.78. There has apparently been no development of commerce as a result of the improvement. The existing commerce other than logs is insignificant, and the logs can be brought out at high stages without improvement. The district officer is of opinion that no further expenditures on the stream are justified, and he recommends that the project be abandoned, in which recommendation the Board of Engineers for Rivers and Harbors concur. The division engineer recommends that moderate expenditures for snagging be continued.

3. After due consideration of the above-mentioned reports, I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the abandonment of the project for improvement of Bear Creek, Miss.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
August 8, 1916.

The Chief of Engineers, United States Army:

1. The following report on Bear Creek, Miss., is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads:

> And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made.

2. Bear Creek rises in Mosquito Lake, in Laflore County, and empties into the Yazoo River about 6 miles above Belzoni, Miss. Its length is about 90 miles. The navigable portion, 25 miles long, includes Threemile, Sixmile, Fourmile, and Wasp Lakes, which have an aggregate length of 12 miles.

3. The existing project, adopted by the river and harbor act of June 25, 1910, contemplates the removal of obstructions from the waterway connecting these lakes, at an estimated cost of $3,000 the

first year and $2,500 for a repetition of the work at the end of three years, the question of subsequent maintenance to be decided after the above work has been accomplished and its effect upon commerce noted. There has been expended under the project $5,432.78, resulting in the removal of the greater part of the obstructions. At present a draft of about 6 feet can be carried at ordinary high stages, while at low stages the available depth is about 1 foot.

4. It appears from the commercial statistics available that during the past four years the total general commerce of this waterway has amounted to about 187 tons and that 15,732 tons of logs were barged out of the creek. The movement of general merchandise is in the autumn when only the minimum depth is available, and the district officer states that this traffic seems well served by existing highway and railroad facilities. He reports the locality as unworthy of further expenditures, and recommends the abandonment of the project. He estimates the cost of continuing the improvement at $2,000 a year. The division engineer believes that the improvement should not be entirely abandoned, and recommends a moderate expenditure for snagging.

5. Interested parties were informed of the present investigation and given an opportunity of submitting their views on the subject. Only one communication has been received, and this favors the abandonment of the improvement.

6. This is a small waterway navigable only at the higher stages. The expenditures already made have been of little benefit, as apparently there has been no increase in commerce. The logs can be brought out at high stages without improvement, and the general commerce is too insignificant to receive consideration. The board therefore concurs with the district officer and recommends legislation authorizing the abandonment of the project for Bear Creek, Miss.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF BEAR CREEK, MISS.

United States Engineer Office,
Vicksburg, Miss., May 2, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Reexamination of Bear Creek, Miss.

1. In compliance with instructions contained in third indorsement from your office dated May 29, 1915, report is herewith submitted on the existing project for the improvement of Bear Creek, Miss. These instructions were issued under authority of a paragraph contained in section 14 of the river and harbor act approved March 4, 1915, which reads as follows:

> **And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made.**

2. The watershed drained by this stream extends over a small portion of Sunflower, Leflore, and Washington Counties, Miss. The creek rises in Mosquito Lake in Leflore County, about 1 mile south of Ittabena, flows south forming the connecting link between Onemile, Threemile, Sixmile, Fourmile, and Wasp Lakes, and enters Yazoo River about 6 miles above Belzoni, Miss. The entire length of the waterway is about 90 miles. The section included in the project extends about 25 miles upstream from the mouth, but as about 13 miles of this portion consists of four lakes which need no improvement, work was only required in the remaining 12 miles of connecting waterway.

3. Preliminary examinations of this stream have previously been made in accordance with law and reports submitted as follows: Senate Document No. 69, Forty-seventh Congress, first session; no recommendation. House Document No. 908, Sixtieth Congress, first session; report was favorable to removing obstructions at an initial cost of $3,000, to be repeated after three years at a cost of $2,500.

4. The improvement of this stream was begun by the United States November 25, 1910, and was continued at intervals in 1911 and 1913. The work done widened the channel and removed the greater portion of the trees and undergrowth which obstructed navigation in the waterway which connects the four lakes. Since June 30, 1914, no work has been done as no funds were available. The total expenditures under the existing project to date are $5,432.78, of which $3,346.62 was for original work and $2,086.16 was for maintenance. There has been no local cooperation.

5. The present condition of this stream is such that at high stages a maximum draft of about 6 feet can be carried over the shoalest places, while at low stages although a draft of 1 foot is nominally possible there is actually no navigation worthy of mention. The variation between high and low water is about 15 feet. The channel is fairly free from obstructions. The portion of the creek included in the project is crossed by two drawbridges, one with 40 and one with 60 feet clear opening. The least clear height above mean high water is about 5 feet.

6. Bear Creek empties into the Yazoo River, which furnishes a navigable approach with a least available depth of 4 feet during the entire year.

7. The present project was adopted in order to give water transportation to the cotton and lumber industries located in the immediate vicinity of this stream, and in recommending this project the Board of Engineers for Rivers and Harbors approved the suggestion that the question of maintaining the project be left for decision until after the work had been accomplished and its effect upon the commerce of the locality noted. (H. Doc. No. 908, 60th Cong., 1st sess.)

8. The stream was made navigable by December, 1911, and in the four years which have elapsed since that time there has been reported to this office a total volume of freight carried over this stream amounting to 187 tons, value $13,976, with an average haul of 6 miles. A closer investigation of the situation develops the fact that of the commerce reported as carried over "the Yazoo and its tributaries" the following tonnage of logs has been barged over Bear Creek as part of the route, without having been reported to this office as freight

which should be credited to Bear Creek. The value of freight and average length of haul on Bear Creek are not known.

	Tons.
1912	374
1913	7,152
1914	5,543
1915	2,663
	15,732

Four thousand four hundred and forty-five tons were carried in 1910 and 1911, before the improvement was completed.

9. The 187 tons consisted of cotton and general merchandise and may be considered as a measure of the value of this improvement to the community at large; the 15,732 tons of logs may be considered as a measure of the value of this improvement to the individual lumber company which bought and transported these logs. This lumber company is not located on Bear Creek.

10. The high water or navigable stage of this stream occurs between the first of January and the end of June. The chief movement of cotton and general merchandise takes place during the fall months, when as a rule this stream has its minimum depth, and this traffic seems to be well served by the existing highway and railroad facilities. The improvement has had no effect upon freight rates.

11. There are no terminal or transfer facilities under public control, and no water power possibilities are involved in the improvement of this stream. No questions of land reclamation, protection from floods, or other special features involving cooperation by local interests have been encountered which require consideration at the present time.

12. Three blue prints[1] of a small sketch map of the river are sent herewith. This map was prepared to accompany the annual report of this district for the fiscal year ending June 30, 1913. The tracing of this map was sent to the office of Chief of Engineers with letter from this office dated July 29, 1913.

13. In view of these facts I do not believe that any further expenditures on this stream are justified, and I recommend that the project be abandoned.

HAROLD C. FISKE,
Major, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, WESTERN DIVISION,
St. Louis, Mo., May 4, 1916.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. While the division engineer is opposed to appropriations for increasing the depths of the minor tributaries of the Mississippi River at the present time, he does not believe it will be good policy to entirely abandon them, and recommends that the moderate expenditures for snagging be continued.

C. McD. TOWNSEND,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors, see p. 2.]

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[1] Not printed.

LETTER OF MR. S. CASTLEMAN.

BELZONI, MISS., *June 8, 1916.*

GENTLEMEN: Referring to yours of the 6th instant, relative to the improvement of Bear Creek, Miss.: This project should by all means be abandoned, for the reason that even though it was cleaned out the stage of water would not permit navigation more than about 90 days in any one year, and the Southern Railway Co. in Mississippi has a line parallelling this creek; therefore the invoice value of every dollar's worth of traffic that goes up and down it by water would not amount to as much as the cost of cleaning it. The National Government should by all means abandon all such projects as this and expend their available funds in something that will be of some benefit to the general public.

Yours, very truly,

S. CASTLEMAN.

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

64TH CONGRESS, } HOUSE OF REPRESENTATIVES. { DOCUMENT
2d Session. } { No. 1697.

HUDSON RIVER CHANNEL, NEW YORK HARBOR, N. Y.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF NEW YORK HARBOR, N. Y., WITH A VIEW TO SECURING AN INCREASE IN DEPTH UP TO 40 FEET AND SUITABLE WIDTHS IN THE NORTH OR HUDSON RIVER CHANNEL FROM DEEP WATER IN THE UPPER BAY AS FAR NORTH AS SPUYTEN DUYVIL CREEK.

DECEMBER 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 8, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, of yesterday's date, together with copies of reports from Col. H. Taylor, Corps of Engineers, dated August 31 and November 8, 1916, with map, on preliminary examination and survey, respectively, of Hudson River Channel, New York Harbor, N. Y., made by him in compliance with the provisions of the river and harbor act approved July 27, 1916.

Very respectfully,

NEWTON D. BAKER,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, December 7, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Hudson River Channel, New York Harbor, N. Y.

1. There are submitted herewith for transmission to Congress reports dated August 31 and November 8, 1916, with map, by Col.

H. Taylor, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act approved July 27, 1916, of "New York Harbor, N. Y., with a view to securing an increase in depth up to 40 feet and suitable widths in the North or Hudson River Channel from deep water in the upper bay as far north as Spuyten Duyvil Creek."

2. The section of the harbor included under the name of Hudson River Channel extends from Ellis Island to the northern limits of New York City, a distance of about 16 miles. The width of the river within these limits varies from 2,725 to 5,400 feet. Originally the widths at various points were much greater, but they have been reduced as a result of water-front improvements and successive advances of the pierhead line to permit the lengthening of piers in keeping pace with the continuing increase in the size of trans-Atlantic steamships. A channel having a mean low-water depth of 40 feet and over and a minimum width of 1,000 feet extends throughout and some distance beyond the section covered by this examination. There are three extensive shoal areas bordering the channel in this reach, however, one off the Jersey City shore, extending from Ellis Island to Castle Point; one on the same shore, from Weehawken to above the northern limits of New York City; and the third on the New York shore, from West Nineteenth to about West Seventy-fifth Streets. Some work on each of these shoals is contemplated under the present project, including the removal of the last-named shoal from West Nineteenth Street to West Thirty-second Street. Between West Forty-fourth and West Fifty-sixth Streets the city of New York has undertaken the construction of one pier 1,000 feet long, and proposes to construct two additional long piers at this site practically in continuation of the work now in progress. In order that these piers may be available for use by trans-Atlantic steamships upon completion, the district officer believes that the shoal along this front should be removed to a depth of 40 feet at mean low water from West Thirty-second Street to West Sixty-first Street. Between the Battery and Canal Streets the channel is too narrow for safe navigation by the trans-Atlantic vessels, especially in view of the enormous traffic in this section by vessels traveling in all directions. In the opinion of the district officer, giving due consideration to economy, a width of 2,000 feet for the 40-foot channel in this section should be adopted for the present. He reaches the conclusion, in which the division engineer concurs, that the locality is worthy of additional improvement at the present time to the extent indicated, at a total estimated cost of $1,320,000.

3. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors and attention is invited to its report herewith, dated November 14, 1916, concurring in the views of the district officer and division engineer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of the Hudson River Channel, New York Harbor, is deemed advisable to the extent of removing the shoal along the New York water front between West Thirty-second and West Sixty-first Streets to a depth of 40 feet,

and increasing to 2,000 feet the width of the 40-foot channel between the Battery and Canal Street, Manhattan Borough, at an estimated cost of $1,320,000. The annual cost of maintenance can not be estimated at the present time, but the indications are that it will be nominal. The first appropriation should be $600,000, and the balance should be appropriated so as to complete the work within a period of three years.

W. M. BLACK,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
November 14, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following is in review of the district officer's reports authorized by the river and harbor act of July 27, 1916, on preliminary examination and survey of "New York Harbor, N. Y., with a view to securing an increase in depth up to 40 feet and suitable widths in the North or Hudson River Channel from deep water in the upper bay as far north as Spuyten Duyvil Creek."

2. The portion of the Hudson River covered by this investigation extends from Ellis Island to the northern limits of New York City, a distance of about 16 miles. A channel having a mean low-water depth of 40 feet and over extends throughout this section, but the width at certain localities is less than is required for the safety of the large and congested traffic. The mean tidal range is 4.4 feet at the Battery and 3.7 feet at Spuyten Duyvil Creek.

3. There are three extensive shoal areas in this section of the river—one off the Jersey City shore extending from Ellis Island to Castle Point, one on the same shore from Weehawken to above the northern limits of the city of New York, and the third on the New York shore from West Nineteenth to about West Seventy-fifth Streets. Some work on each of these shoals is contemplated by the existing project, as explained by the district officer.

4. The magnitude of the commerce using the Hudson River is shown by the statement that during 1915 the arrivals and departures of vessels numbered 1,557,734, or an average of 4,200 per day. The freight amounted to 63,458,291 tons, valued at over $6,000,000,000.

5. The city of New York is engaged upon extensive pier construction in the vicinity of West Forty-sixth Street for the accommodation of the largest trans-Atlantic vessels. It is expected that the first unit of this development will be completed in 1917. In order that it may be used by the deepest draft vessels, dredging to a depth of 40 feet on the shoal between Thirty-second and Sixty-first Streets is proposed. Experience has shown that the present width of the natural 40-foot channel between the Battery and Canal Street is inadequate for the enormous commerce of this section, and it is proposed to widen on the New Jersey side so as to give a clear width of 2,000 feet.

6. Estimates are submitted as follows:

Removal of shoal along the New York water front between West Thirty-second and West Sixty-first Streets	$678,000
Increasing the width of the channel between the Battery and Canal Street, Manhattan Borough, to 2,000 feet	524,000
Engineering, superintendence, and contingencies	118,000
Total	1,320,000

The district officer is of opinion that improvement to this extent is advisable, and the division engineer concurs in this view.

7. It is apparent that the piers now under construction by the city for the accommodation of transatlantic steamers can not be used until the adjacent shoal is removed. This work is considered of prime importance in connection with the general development of the harbor. The great increase in the number and size of vessels engaged in traffic on this section of the river calls for a wider fairway than now exists between Jersey City and lower Manhattan. The width of 2,000 feet proposed is considered sufficient for present needs. The cost of these improvements is not excessive when compared with the probable additional safety and general benefits to be anticipated, and therefore the board concurs in the opinion of the district officer and the division engineer that it is advisable for the United States to undertake the work approximately as shown on the map, at a total estimated cost of $1,320,000. It seems impracticable to estimate the cost of maintenance at this time, but it is not believed that it will be unduly high. The first appropriation should be $600,000, and the balance should be appropriated so as to complete the work within a period of three years.

8. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects so related to the project proposed that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interests of navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF HUDSON RIVER CHANNEL, NEW YORK HARBOR, N. Y.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
FIRST DISTRICT,
New York City, August 31, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Hudson River Channel, N. Y.

1. The following report upon a preliminary examination of Hudson River Channel, N. Y., is submitted in compliance with instructions from the Chief of Engineers, United States Army, dated August 4, 1916, and pursuant to the requirements of the river and harbor act of July 27, 1916, as follows:

New York Harbor, N. Y., with a view to securing an increase in depth up to 40 feet and suitable widths in the North or Hudson River Channel from deep water in the upper bay as far north as Spuyten Duyvil Creek.

2. New York Harbor comprises what is known as the lower bay and the upper bay or harbor proper, together with numerous subsidiary channels and waterways. The area of the lower bay, including that portion between a line joining the point of Sandy Hook with the point of Far Rockaway Beach, The Narrows, and entrance to Staten Island Sound is 121 square miles. Of this area 5,573 acres have a depth of 30 feet or more. The principal channels through the lower bay are Ambrose Channel, having a project depth of 40 feet and a width of 2,000 feet, and the Main Ship-Bayside-Gedney Channel, having a project depth of 30 feet and a width of 1,000 feet, both of which channels have been completed. There is comparatively little wharf development along the shores of the lower bay. The area of the harbor proper, including in addition to the upper bay the Hudson River as far as the city limits, the East River as far as Hell Gate (Mill Rock), the Kill Van Kull, and Newark Bay to the mouth of the Hackensack and Passaic Rivers, amounts to 50 square miles. The shores of the harbor are fairly well lined with wharves, many sections of the shore being completely developed with expensive wharf construction. This is particularly true of the section of the harbor known as the Hudson River Channel.

3. The section of the harbor included under the name of Hudson River Channel extends from Ellis Island to the northern limits of New York City, a distance of about 16 miles. The distance from the Battery to Spuyten Duyvil Creek is about 13½ miles. The widths of the river in this section, measure between established pierhead lines normal to the Manhattan shore, are: At the Battery, 3,900 feet, gradually decreasing to 2,750 feet at West Fourteenth Street, Manhattan, and 2,725 feet at West Fifty-ninth Street; then widening to 5,400 feet at Spuyten Duyvil Creek, whence it maintains this width to the northern boundary of New York City.

Originally the widths were much greater. The present reduced widths are the result of water-front improvements and successive advances of the pierhead line to permit of the lengthening of piers in keeping pace with the continuing increase in the size of transatlantic steamships. The largest of these are now over 900 feet long, about 100 feet beam, and have a loaded draft of 38 feet.

4. A channel having a mean low-water depth of 40 feet and over extends throughout and some distance beyond the section under consideration. This channel is about 2,500 feet wide at the mouth of the river off Ellis Island, but narrows rapidly to from 900 to 1,200 feet between the Battery and Canal Street. Above Canal Street it is somewhat wider, narrowing again to about 1,100 feet off Edgewater, N. J., and 600 feet at the northern end of the section.

There are three extensive shoal areas in this section of the river. Some work on each of these is contemplated by the existing project for Hudson River Channel. One of these shoals extends along the New York shore from West Nineteenth Street to about West Seventy-fifth Street; another extends along the New Jerey shore from below Jersey City to Castle Point; and the third, also along the New Jersey shore, from Weehawken to above the northern limits of the city of

New York. The least depths found over these shoals at pierheads before any work of improvement was done by the United States were 21 feet, 20 feet, and 7 feet, respectively. The mean tidal range at the Battery is 4.4 feet and at Spuyten Duyvil Creek it is 3.7 feet.

5. On the New York side the whole of the water front from the Battery to West Seventy-second Street is occupied by piers, bulkheads, and ferry slips; above this rocky bluffs approach closely to the river bank, except for short stretches, making this section very diffcult of access for water-borne commerce. The shore from West Seventy-second Street to West One hundred and twenty-eighth Street, known as Riverside Park, has been set aside for park purposes and is closed to commercial development.

6. On the New Jersey shore the water front from the mouth of the river at Jersey City up to Weehawken is entirely taken up by piers, bulkheads, and ferry slips; above this to Edgewater about 40 per cent of the water front is still available for new construction. During the past year there has been considerable activity in this latter section in the development of facilities for water-borne commerce.

7. The first report (see H. Doc. No. 158, 43d Cong., 2d sess., and Annual Report for 1875, p. 216) upon an examination with a view to improvements in this section of the Hudson River was submitted to the Chief of Engineers February 1, 1875. The project recommended in this report provided for dredging to a depth of 25 feet at mean low water from the neighborhood of Pavonia Ferry to a short distance below the Cunard docks, over an area of 223,500 square yards. Under date of April 5, 1877 (Annual Report for 1877, p. 246), it was recommended that no further work be done under this project. The amount expended thereunder was $25,000.

Further reports (see S. Doc. No. 118, 48th Cong., 1st sess., and Annual Reports for 1884, p. 774, and 1885, p. 791) were submitted to the Chief of Engineers February 16, 1884, and February 27, 1885. Neither of these reports recommended the appropriation of funds for expenditures in improving the channel.

Joint resolution of Congress of July 1, 1902, and the river and harbor act of March 3, 1905, authorized the diversion of not exceeding $45,000 from appropriations already made or authorized for the improvement of Ambrose Channel, New York Harbor, for the removal of a rock or obstruction in the North River, New York Harbor, near Pier 1 (known as Pier A) to a depth of 40 feet at mean low water. There was expended $43,979.12 in removing this rock to 38 feet at mean low water.

The existing project adopted by the river and harbor act of March 4, 1913, and modified by river and harbor act of March 4, 1915 (Annual Report for 1914, pp. 234 and 235), is based on a report printed in House Document No. 719, Sixty-second Congress, second session. As modified it provides for a channel 800 feet wide and 30 feet deep at mean low water from deep water off Ellis Island to 1,300 feet below the foot of Newark Street, Hoboken; thence to Castle Point, the removal of a shoal to a depth of 40 feet; a channel 550 feet wide and 26 feet deep along the Weehawken-Edgewater water front; the removal to a depth of 40 feet of ledge rock lying about 1,000 feet southwest of Pier A at the Battery; the removal of a shoal on the New York side, between West Nineteenth and West Thirty-second Streets, to a depth of 40 feet; and the removal of an obstruction north of the mouth of Spuyten Duyvil Creek to the depth of the surrounding river bottom. Estimated cost, $1,570,000.

8. Work under the existing project was commenced April 2, 1913. The expenditures thereunder up to the date of this report amount to $560,204.05, all of which has been expended for new work, and has resulted in dredging a channel in the Jersey City water front 200 feet wide and 30 feet deep; in completing the removal of the shoal in the Hoboken water front to a depth of 40 feet; and in dredging a channel in the Weehawken-Edgewater water front 250 feet wide and 26 feet deep. The controlling depths in the dredged channels are estimated at 30 feet in the Jersey City water front, 40 feet in the Hoboken water front, and 24 feet in the Weehawken-Edgewater water front.

The funds appropriated by the river and harbor act of July 27, 1916, are to be expended in widening the dredged channels in the Jersey City and the Weehawken-Edgewater water fronts by dredging.

Except for the improvements made as outlined above, the channel is as described in paragraphs 3 and 4 above.

9. The arrivals and departures of vessels of all classes using the Hudson River Channel during the calendar year 1915, as determined by a careful canvass, numbered 1,557,734, or an average of over 4,200 per day.

10. The freight handled in Hudson River Channel in the calendar year of 1915, as determined after a careful investigation, amounted to 63,458,291 short tons, valued at $6,410,144,119, and the passengers carried numbered 69,239,418. Of the freight handled 22,412,946 tons represent the traffic on the New York side, 22,218,684 tons the traffic on the New Jersey side, 3,887,718 tons the through traffic in both directions, and 14,938,943 tons on either or both sides, but unclassified as to location in the returns received.

11. On September 18, 1912, and December 26, 1912, the New York Harbor Line Board gave public hearings on applications by several trans-Atlantic steamship companies for permission to extend their piers about 100 feet in the Chelsea District, New York City (vicinity of Twenty-third Street), and also by the local authorities for the extension of the pierhead line in both the New York and New Jersey water fronts. The extensions desired by the applicants were for the purpose of permitting the construction of piers suited to accommodate longer ships already constructed and others then in course of construction.

In its final report on these hearings dated January 9, 1913, the board recommended that no further extension of the pierhead line be permitted in the reach between the foot of Gansevoort Street and West Thirtieth Street, New York, for the following reasons:

"(*a*) Because the regimen of the Hudson has been changed by the narrowing made heretofore, and the current velocities markedly increased * * *. (*b*) Because in the opinion of the board a fairway of at least 3,000 feet is necessary to provide with safety for traffic of the river. (*c*) Because with piers on two sides of the river at least 3,000 feet * * * is necessary for safety in docking and undocking two long steamers simultaneously * * *."

In a preliminary report on these hearings, dated October 21, 1912, the board recommended temporary expedients to meet an alleged emergency. This recommendation having been approved, permits were accordingly granted the city of New York for temporary pile and timber extensions to certain piers in the Chelsea district for a period not to exceed three years from June 30, 1913, pending the construction of a new pier by the city of New York in the wider portion of the river.

On December 5, 1912, the Board of Estimate and Apportionment adopted a policy looking to the construction of long piers between West Forty-fourth and West Fifty-sixth Streets, Manhattan, as the needs of commerce might require, a locality in which no change of pierhead line is asked or recommended. The work of constructing one pier to be 1,000 feet long was commenced November 1, 1913, the desired additional pier length being obtained by excavation at the landward end. This excavation and all rock removal, as well as the construction of the shore end of the piers, was done in the dry by use of an extensive cofferdam. The rock excavation has been completed, about 800 feet in length of the pier has been built, and the cofferdam is now being removed. The work of constructing additional long piers at this site is to be undertaken as the necessities of commerce require.

Though the city of New York prosecuted the work vigorously, it could not complete it within the time limit of the permit granted for temporary pier extensions in the Chelsea district. The time limit was therefore, on request, extended by the Secretary of War for a further period of two years from June 30, 1916.

12. It is expected that the pier now under construction will be completed in 1917. It will not, however, be available for large steamers until the shoal now obstructing the approach thereto has been removed to a depth of 40 feet. Rock excavation will not be necessary. The material composing the shoal consists of river silt, and can therefore be removed in a comparatively short time by dredging. It will be necessary, however, to commence the work of dredging at as early a date as possible if the pier is to be available upon its completion for the use intended. The existing project provides for the removal to a depth of 40 feet of only that part of this shoal situated between West Nineteenth and West Thirty-second Streets, which section has been the berthing site for large steamships for a long time, and no doubt will continue to be so used in the future. The construction of the new piers was undertaken after the adoption of the existing project. In order that these new piers may be used for the purpose designed, dredging in this front, in addition to that provided for under the existing project, is necessary, and the channel for the large trans-Atlantic steamships should be widened between the Battery and Canal Street.

13. There are no questions of terminal facilities, water power, or other subjects which could be so coordinated as to lessen the cost of the work and compensate the Government for expenditures made in the interests of commerce and navigation under any proposed project for improvement.

14. In my opinion, Hudson River Channel is worthy of further improvement by the United States. While the major part of the

data necessary for a study of the needs of the locality and for estimating the cost of improvement is already available, additional information is needed. It is recommended, therefore, that the necessary survey for securing it be authorized.

H. TAYLOR,
Colonel, Corps of Engineers.

[First indorsement.]

THE DIVISION ENGINEER,
NORTHEAST DIVISION, NEW YORK CITY,
September 5, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

Forwarded, concurring in the recommendation of the district engineer officer.

FREDERIC V. ABBOT,
Colonel, Corps of Engineers.

[Third indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
September 12, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. For reasons stated herein, the board concurs with the district officer and the division engineer in recommending a survey in order to determine the extent and advisability of the improvement.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers.
Senior Member of the Board.

SURVEY OF HUDSON RIVER CHANNEL, NEW YORK HARBOR, N. Y.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
FIRST DISTRICT,
New York City, November 8, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Report on survey of Hudson River Channel, N. Y.

1. The following report on a survey of Hudson River Channel, N. Y., is submitted in compliance with department letter of September 15, 1916, and pursuant to the requirements of the river and harbor act of July 27, 1916. A report upon the preliminary examination of this channel was submitted August 31, 1916; attention is invited to it for a description of the locality and of the existing project for improvement, and to a statement of the facts upon which is based the opinion expressed therein as to the worthiness of the improvement.

2. The area surveyed, shown on the accompanying map, covers a shoal extending along the New York shore from West Nineteenth Street to West Ninety-sixth Street, Manhattan Borough, New York City. The data thus secured together with that available from

surveys made under the existing project; information published in "Bulletin No. 270, Series B, Descriptive Geology, 73," United States Geological Survey, pages 36 to 41; and data obtained from the records of tunnel construction under the bed of the river, shows that the material lying within the area herein considered for improvement consists of mud and river silt down to a much greater depth than is considered necessary for navigation by the largest steamships. Therefore any work of excavation that may be undertaken here can be accomplished both with comparative economy and within a comparatively short time.

3. The need of further improvement in this section of the Hudson River is apparent from the data submitted in my preliminary report. To what extent this improvement should be carried in order to meet the reasonable requirements of both the existing and prospective commerce of the river has received further careful study since submitting that report. The result of this study has strengthened my opinion as to the vital importance to the commerce of New York City for the removal of part of the shoal referred to with the least practicable delay and to the necessity for widening the channel between the Battery and Canal Street. The city of New York has made good progress in its work of pier construction. It is now expected that the pier at West Forty-sixth Street and a one-half pier adjoining it on the north will be completed early in 1917 and that the pier sheds will be completed not later than the autumn of 1917. A close estimate of the cost of this work is placed at $1,800,000. In order that these piers may be available for use by trans-Atlantic steamships upon completion the shoal along this front should be removed to a depth of 40 feet at mean low water a sufficient time in advance of the time of their completion to make it possible for the city of New York to make arrangements for their occupancy without loss of time.

Examination of the site of two additional piers, to cost about $4,000,000, is now in progress immediately north of the site of the present work of construction. It is the intention to undertake the construction of these two additional piers practically in continuation of the work now in progress. Proceedings for the acquisition of the necessary lands are now under way.

4. As stated in the preceding paragraph, provision should be made for widening the deep-water channel between the Battery and Canal Street, Manhattan Borough. An examination of the accompanying map will show that the width of the present channel is too narrow for safe navigation by the large trans-Atlantic steamships. The enormous traffic in this section by vessels traveling in all directions and their legal liability in passing closer than 300 feet from pierheads for damages to craft entering or leaving their slips renders navigation here extra hazardous. Giving due consideration to economy in the expenditure of funds, it has been concluded that a width of 2,000 feet should be adopted for the present. Should this width prove to be insufficient, further widening can be then provided for.

5. It is believed that by the removal of the shoal along the New York water front from West Nineteenth to West Sixty-first Streets, widening the channel between the Battery and Canal Street to 2,000 feet, and completing the work provided for under the existing project the present needs of navigation will be fairly met. The removal of

that part of the shoal along the New York water front lying between West Nineteenth and West Thirty-second Streets is already included as part of the work to be accomplished under the existing project. The water front from West Sixty-first Street to West Seventy-second Street is taken up by the New York Central Railroad as a place for the transfer of its cars to and from car floats, and the depth here is sufficient for present and prospective use. Above West Seventy-second Street the water front is taken up for park purposes, thus eliminating it as a section for consideration in water-front improvements for commercial purposes.

6. As the result of data secured by investigation and survey it is my opinion that Hudson River Channel is worthy of improvement in the localities and to the extent provided for in the following estimate of the cost:

Removal of shoal along the New York water front between West Thirty-second and West Sixty-first Streets	$678,000
Increasing the width of the channel between the Battery and Canal Street, Manhattan Borough, to 2,000 feet	524,000
Engineering, superintendence, and contingencies	118,000
Total	1,320,000

The annual cost of maintenance can not be estimated until after some experience has been gained from work done. However, past investigation has shown that the amount of material carried into this section of the Hudson River from points above is very small.

7. It is of the greatest importance to trans-Atlantic commerce that work upon the removal of the shoal along the New York shore be commenced with as little delay as practicable, and that increased width of channel between the Battery and Canal Street be obtained promptly. It is accordingly recommended the amount of the first appropriation be $600,000, and that thereafter appropriation be made with a view of completing the work within a period of three years.

8. There are no questions of terminal or transfer facilities, development of water power, or other subjects connected with the proposed improvement that can be utilized to lessen the cost of the improvement to the United States.

H. Taylor,
Colonel, Corps of Engineers.

[First indorsement.]

The Division Engineer, Northeast Division,
New York City, November 9, 1916.

To the Chief of Engineers, United States Army:

Forwarded, concurring in the recommendation of the district engineer officer.

Frederic V. Abbot,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors on survey, see p. 3.]

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64th Congress, 2d Session. | HOUSE OF REPRESENTATIVES. | Document No. 1698.

ASHLAND HARBOR, WIS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON REEXAMINATION OF ASHLAND HARBOR, WIS.

December 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

War Department,
Washington, December 6, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated October 23, 1916, together with copy of a report from Maj. E. D. Peek, Corps of Engineers, dated January 28, 1916, with map, relative to the project for improvement of Ashland Harbor, Wis., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, October 23, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of Ashland Harbor, Wis.

1. Under authority contained in section 14 of the river and harbor act, approved March 4, 1915, there is submitted herewith for transmission to Congress report dated January 28, 1916, with map, by

Maj. E. D. Peek, Corps of Engineers, relative to the project for improvement of Ashland Harbor, Wis.

2. Ashland Harbor is situated at the head of Chequamegon Bay, 95 miles easterly from Duluth. The present project provides for the construction of a breakwater 8,000 feet long, with a detached arm approximately 4,700 feet long extending to the shore parallel to the main breakwater and 2,600 feet to the eastward; a dike to close a breach in Chequamegon Point at the mouth of the bay, and a dredged channel 20 feet deep and 200 feet wide along the dock front. The total expenditures to June 30, 1915, were $600,674.42, of which $259,994.31 was for new work and $340,680.11 for maintenance. The district officer is of opinion that the closure of the breach in Chequamegon Point is no longer required and that the easterly detached breakwater should be abandoned. He recommends that the project, which has heretofore been somewhat indefinite regarding certain features, be modified to read as follows:

> The construction and maintenance of an 8,000-foot breakwater and the construction and maintenance of a dredged channel 20 feet deep and 200 feet wide along the dock front, 75 feet outside the harbor line, from Ellis Avenue produced, to a point 400 feet westerly of Seventeenth Avenue west produced.

The estimated cost of this project is $269,994.31, including work already accomplished, leaving $10,000 required to complete the improvement. Maintenance is estimated at $6,000 annually. The division engineer and the Board of Engineers for Rivers and Harbors concur in the views of the district officer with the amendment that the depth be defined as 20 feet at low water, 601.6 feet above mean tide at New York.

3. After due consideration of the above-mentioned reports I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors and therefore recommend legislation authorizing the modification and restatement of the project for improvement of Ashland Harbor, Wis., as specified above, the datum plane to be taken as 601.6 feet above mean tide at New York City. The amount required for completion of the modified project, $10,000, should be provided in one appropriation.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 11, 1916.

To the Chief of Engineers, United States Army.

1. The following report on Ashland Harbor, Wis., is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads, "and the chief of engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. Ashland Harbor is situated at the head of Chequamegon Bay, 95 miles easterly from Duluth. It is an important harbor as shown

by its commerce, which amounted to 6,534,410 tons in 1915, and the tonnage is increasing.

3. The existing project, involving a variety of work based upon a number of reports and in some instances without formal estimate or favorable recommendation, is somewhat uncertain, and the purpose of the present investigation is to clear away the obscurity and restate the project to cover existing needs of navigation. The total expenditures to June 30, 1915, were $600,674.42, including $259,994.31 for new work and $340,680.11 for maintenance.

4. The district officer describes the work that has been done, the present condition of the improvement, and the further work considered necessary. He shows that the items in the project providing for an easterly detached breakwater and for closing the breach in Chequamegon Point are no longer required and should be abandoned. He also explains the need for completing the channel along the dock front as recommended in House Document No. 536, Sixty-first Congress, second session. He accordingly recommends that the project be modified to read as follows:

> The construction and maintenance of an 8,000-foot breakwater and the construction and maintenance of a dredged channel 20 feet deep and 200 feet wide along the dock front, 75 feet outside the harbor line, from Ellis Avenue produced, to a point 400 feet westerly of Seventeenth Avenue west produced.

The estimate of cost of the modified project is as follows:

Amount already expended on the project for improvement to date		$259, 994. 31
Amount required to complete the modified project:		
46,000 cubic yards of dredging, at 18 cents per yard	$8, 280	
Administration and contingencies	1, 720	
		10, 000. 00
Total estimate for modified project		269, 994. 31
Estimate for average annual maintenance of breakwater and administration		5, 000. 00
For maintenance of channels		1, 000. 00
Total annual maintenance and administration		6, 000. 00

The division engineer concurs in the recommendations of the district officer, with the amendment that the depth be defined as 20 feet deep at low water, 1 foot below mean lake level, 1860–1875.

5. It will be seen from the foregoing that the expenditures to date have amounted to approximately $600,000, and that the additional amount required to fit the harbor for present and immediately prospective needs is $10,000 for dredging and $6,000 annually for maintenance. These expenditures are amply justified by the commercial interests involved, and the board concurs with the district officer and the division engineer as to the advisability of making the proposed changes in the project. The board therefore recommends legislation authorizing the modification of the project for Ashland Harbor, Wis., as proposed by the district officer, the datum plane to be taken at 601.6 feet above mean tide at New York as suggested by the division engineer. The amount estimated to complete the project as modified, $10,000, should be provided in one appropriation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF ASHLAND HARBOR, WIS.

ENGINEER OFFICE, UNITED STATES ARMY,
Duluth, Minn., January 28, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Modification or abandonment of present project Ashland Harbor, Wis.

1. In accordance with indorsement of the Chief of Engineers, dated May 3, 1915, and section 14 of the river and harbor act approved March 4, 1915, which reads:

> And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made—

the following report on the modification or abandonment of the present project for Ashland Harbor, Wis., is submitted.

2. *Description of locality.*—A general idea of the harbor at Ashland and the contiguous territory can be gained by reference to lake survey chart of the Apostle Islands (Index No. 961) and also to the accompanying map, scale 1 inch equals 4,200 feet, showing the breakwaters and channels with characteristic soundings and other data.

It is situated at the head of Chequamegon Bay on the south shore of Lake Superior 95 miles, by water, east of Duluth and 348 miles west of Sault Ste. Marie. The bay, about 5 by 12 miles, is separated from Lake Superior by Chequamegon Point, a narrow sand spit. The breakwater is located about 7 miles inside of Chequamegon Point and about 1½ miles from the principal wharves of the city.

3. *Present project.*—The present project provides for the construction of a breakwater 8,000 feet long, with a detached arm approximately 4,700 feet long extending to the shore parallel to the main breakwater (prolonged) and 2,600 feet to the eastward; a dike to close a breach in Chequamegon Point at the mouth of the bay; and a dredged channel 20 feet deep and 200 feet wide along the dock front.

This project was adopted by the river and harbor act of August 5, 1886, following a report recommending a breakwater 7,900 feet long at a cost of $125,000 and the removal of an 11-foot shoal in front of the wharves at a cost of $11,000 (H. Ex. Doc. No. 89, 48th Cong., 2d sess.), and a later report recommending a breakwater 8,000 feet long at a cost of $132,377.02 and $10,000 for dredging the shoal to a depth of 12 feet (Annual Report for 1886, p. 1674). The breakwater was to consist of two rows of piles spaced from 12 to 20 feet apart, filled in between with slabs and topped with rock, the width varying with the depth of water. Before any work was begun a board of engineers recommended that the breach in Chequamegon Point be closed and that a channel along the wharf front be dredged to accommodate the largest vessels that could pass the St. Marys Falls Canal, which provided at that time for the passage of vessels drawing 16 feet. (Annual Report for 1887, p. 1966.) The river and harbor act of August 11, 1888, appropriated $60,000 for "continuing improvement on the enlarged project." On the completion of the Poe Lock in 1896 with an available depth of 20 feet the dredging at Ashland

Harbor was carried to a similar depth. By the river and harbor act of March 3, 1899, the extension of the breakwater to the shore was authorized; but the act of June 6, 1900, directed that in lieu of this extension there should be substituted a detached breakwater extending 4,700 feet out from the shore at a point 2,600 feet east of the main breakwater (prolonged) and parallel thereto. In each case the additional work was authorized without formal prior estimate by the War Department.

There was no estimate for maintenance.

Reports were made June 2, 1909, and June 14, 1909 (H. Doc. No. 536, 61st Cong., 2d sess.), with the object of getting authority for increasing the depth of dredging from 16 feet to 20 feet and defining the limits of the dredging, all at an estimated cost of $46,224. This suggested amendment to the project was not adopted by Congress, as the necessary authority for increasing the depth of dredging already existed as stated above.

The legal plane of reference is low-water datum, which is 601.75 feet above mean tide at New York.

4. *Purpose of improvement.*—The objects to be attained are protecting the harbor from seas resulting from north and northeast storms and providing a channel suitable for the needs of commerce along the harbor front.

No public work had been done previous to improvement by the Government. The bay and its approaches had ample natural depth for commerce except along the western harbor front, where there was a natural depth of from 8 to 13 feet at low water. The usual annual variation of water level ordinarily extends from low-water datum to 1 foot above. The higher stages of water prevail from August through the remainder of the season of navigation.

There are no bridges over the navigable waters of the harbor.

The harbor was subject to more or less disturbance from waves generated within the bay, which made it dangerous for vessels to lie on the windward side of docks in northeast storms.

The city of Ashland has 5 miles of harbor frontage which is protected by the breakwater, and its riparian rights are defined by a harbor line which lies at a distance of 2,000 feet or more from the shore.

5. *Commerce.*—The receipts and shipments during 1915 amounted to 6,534,410 short tons, valued at $15,378,873. There are large bodies of iron ore and tracts of timber land tributary which assure a large commerce for the harbor. A blast furnace located in Ashland produces pig iron, which is practically all shipped by water. The surrounding country is also fast developing in agriculture, the products of which may form a factor in the future commerce.

6. *Terminals.*—There are two railroads owning terminals on the harbor front—one, the Chicago & North Western Railway, which owns and operates two large ore docks; the other, the "Soo" Line, which is a subsidiary of the Canadian Pacific Railway. The latter road, in addition to an ore dock, also owns the commercial dock, which is the only wharf doing a general lake-and-rail freight business.

The city owns the frontage at the end of each street extending to the bay which is available for wharves. There is a large amount of room for lake-and-rail commerce and there is no congestion of traffic at present or likely to occur. The two railway companies own about one-fifth of the harbor front. The remainder is owned by various companies and private parties. Much of it consists of abandoned sawmill sites, where formerly a large amount of lumber was manufactured, and which is now available for wharves and slips. There is also considerable space available which has never been improved.

There is no water power in the immediate vicinity of the harbor.

7. *Work accomplished.*—The following work has been accomplished under the project: A breakwater 8,000 feet long was constructed as proposed in the original project. A portion of the shore connection, provided for in the modification of March 3, 1899 (91 feet in length), was built in 1900. This is located near shore on the line of the main breakwater, but detached and uncompleted. The shore connection was abandoned by the act of June 6, 1900. A portion (842 linear feet) of the breakwater provided for in the river and harbor act of June 6, 1900, was constructed in the same year. The original 8,000-foot structure was maintained by revetting with sandstone alone, excepting a length of 2,699 feet, which was later covered with granite rock. An improved channel 5,760 feet long, extending from abreast Ellis Avenue to Seventeenth Avenue west produced, 20 feet deep and 200 feet wide, with the exception of the westerly 800 feet, which is 150 feet wide, was dredged.

A breach in Chequamegon Point was closed in 1891–92 by a dike 4,200 feet in length. As a result of the improvements made the harbor is protected from disturbances caused by north and northeast storms, except a small portion of the unoccupied harbor front in the vicinity of the breakwater. The improved channel gives access to the wharves along the harbor front and is of such a depth as to accommodate the largest lake vessels.

Some difficulty is experienced in turning vessels entering or departing from the Lake Superior Iron & Chemical Co. wharf, which is abreast the extreme westerly end of the improved Government channel.

The amount expended on the project to the close of the fiscal year 1915, not including outstanding liabilities, is $600,674.42, of which $259,994.31 was for new work and $340,680.11 for maintenance.

8. *Discussion.*—The breach in Chequamegon Point was closed by a dike 4,200 feet long in 1891. This was subsequently repaired in 1893. Other breaches have occurred in 1894 and subsequent dates, which have not been closed for several reasons. First, because there was no fear of permanent damage, as the same forces that built the point up would probably maintain it. Second, the people of Ashland entered objection to closing the breaches, claiming that they gave a better circulation of water in the bay, from which the city obtains its water supply. Third, the breakwater protects the harbor and the wharves of the city from any disturbance caused by any waves entering through the breach.

A portion of the easterly breakwater (act of June 6, 1900) was constructed in 1900. No work has been done on this breakwater since that time. In the Annual Report for 1910, page 2073, will be found the following:

> This breakwater was never recommended by the district officer, nor by the department at Washington. The authorizing act was due to the efforts of private parties in Ashland who had projects for improvement in that locality which

would be benefited by such a breakwater. The projects for private improvement were never carried out, and the chief promoter has died.

The occasion for building this breakwater, if it were ever justified at all, has now passed away. There is ample room available to the west of the main breakwater and under its protection for any and all possible future private improvements along the Ashland Harbor front, as far as can now be foreseen.

9. *Résumé.*—In view of the foregoing it appears advisable that the closing of the breach in Chequamegon Point and the construction of the easterly breakwater be abandoned, and that the length of the proposed channel (about 75 per cent completed) be defined.

The harbor is important commercially, the tonnage handled in its waters being large, and it is therefore considered worthy of continued maintenance and improvement.

10. *Recommendation.*—It is recommended that the project for Ashland Harbor be modified to read as follows: "The construction and maintenance of an 8,000-foot breakwater and the construction and maintenance of a dredged channel 20 feet deep and 200 feet wide along the dock front, 75 feet outside the harbor line from Ellis Avenue produced, to a point 400 feet westerly of Seventeenth Avenue west produced."

11. *Estimate of cost.*—The estimate of cost of the modified project is as follows:

Amount already expended on the project for improvement to date		$259,994.31
Amount required to complete the modified project:		
46,000 cubic yards of dredging, at 18 cents per yard	$8,280.00	
Administration and contingencies	1,720.00	
		10,000.00
Total estimate for modified project		269,994.31
Estimate for average annual maintenance of breakwater and administration		5,000.00
For maintenance of channels		1,000.00
Total annual maintenance and administration		6,000.00

E. D. PEEK,
Major, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, LAKES DIVISION,
Buffalo, N. Y., February 1, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. Forwarded.

2. The general locality is shown on Lake Survey chart, Lake Superior Coast Chart No. 6, Index No. 96.

3. The recommendation by the district officer in paragraphs 10 and 11 of his report is concurred in, subject to amendment of paragraph 10, as follows: "* * * dredged channel" 20 feet deep at low water, 1 foot below mean lake level, 1860–1875, "and 200 feet wide."

J. G. WARREN,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

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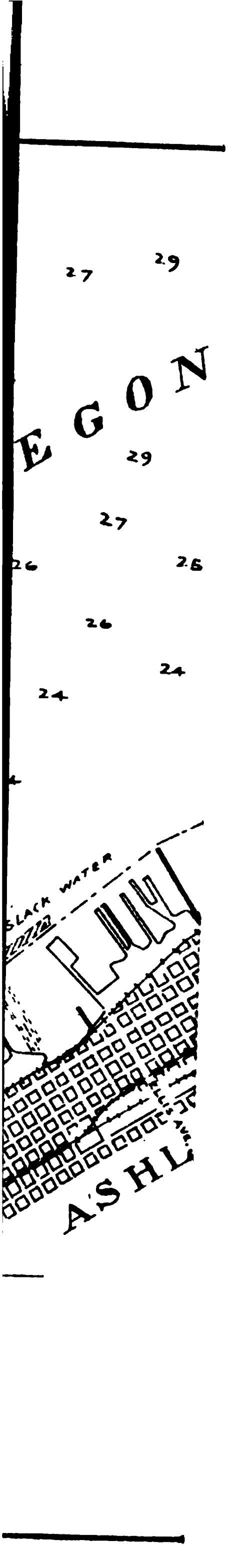
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64th Congress, 2d Session. } HOUSE OF REPRESENTATIVES. { Document No. 1699.

ST. CROIX RIVER, MINN. AND WIS., UP TO TAYLORS FALLS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION OF ST. CROIX RIVER, MINN. AND WIS., FROM THE MOUTH TO TAYLORS FALLS, WITH A VIEW TO THE REMOVAL OF LOGS AND OTHER OBSTRUCTIONS, CONSIDERATION BEING ALSO GIVEN TO THE QUESTION OF COOPERATION ON THE PART OF LOCAL INTERESTS IN THE CONSTRUCTION OF HARBORS, LEVEES, AND TERMINALS AT VARIOUS POINTS ALONG SAID RIVER.

December 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

War Department,
Washington, December 6, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, together with copy of a report from Maj. E. D. Peek, Corps of Engineers, dated May 27, 1916, on a preliminary examination of St. Croix River, Minn. and Wis., from the mouth to Taylors Falls, made by him in compliance with the provisions of the river and harbor act approved July 25, 1912.

Very respectfully,

Newton D. Baker,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, October 23, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination of St. Croix River, Minn. and Wis.

1. There is submitted herewith for transmission to Congress report dated May 27, 1916, by Maj. E. D. Peek, Corps of Engineers, on preliminary examination authorized by the river and harbor act approved July 25, 1912, of St. Croix River, Minn. and Wis., "from the mouth to Taylors Falls, with a view to the removal of logs and other obstructions, consideration being also given to the question of cooperation on the part of local interests in the construction of harbors, levees, and terminals at various points along said river."

2. The St. Croix River has a length of about 160 miles and empties into the Mississippi River at Prescott, Wis., 26.9 miles below St. Paul, Minn. For the greater part of its length it forms the boundary between Wisconsin and Minnesota. The distance from Taylors Falls to the head of Lake St. Croix is about 27 miles. Lake St. Croix, which extends down to the mouth of the river, is 25.3 miles long and from 1,500 to 6,500 feet wide. The present project was adopted by the river and harbor act of June 19, 1878, and provides for the improvement of the river between the mouth and Taylors Falls, Minn., by means of dredging, wing dams, and bank protection in order to obtain a channel depth of 3 feet at mean low water. By the act of June 3, 1896, the improvement of the harbor and water front at Stillwater was added to the project. Expenditures to June 30, 1915, were $156,487.34. Excursion business constitutes the principal commerce on the river. During the season of 1915, about 8,500 passengers were carried, and a small amount of timber and lath was rafted out of the river. It appears that formerly, when the logs were floated down the stream, large numbers were left in the channel and on the banks, resulting in innumerable sunken logs and deadheads which obstructed navigation. Logging operations have recently been suspended, however, and during the past two years many sunken logs have been removed from the stream, and further removal of these obstructions is contemplated under the existing project. The district officer states that the present project covers the requirements of such navigation as now exists. No offers of cooperation in the construction of harbors, levees, and terminals have been received, and he is of opinion that the locality is not worthy of improvement by the United States for the purpose of cooperating in the construction of harbors, levees, and terminals. The division engineer concurs in this opinion.

3. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 11, 1916, concurring in the views of the district officer and the division engineer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors and, therefore, report that the improvement by the United States of St. Croix River,

Minn. and Wis., from the mouth to Taylors Falls, is not deemed advisable to a greater extent than is now authorized by the existing project.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 11, 1916.

To the Chief of Engineers, United States Army.

1. The following is in review of the district officer's report authorized by the river and harbor act of July 25, 1912, on preliminary examination of St. Croix River, Minn. and Wis., "from the mouth to Taylors Falls, with a view to the removal of logs and other obstructions, consideration being also given to the question of cooperation on the part of local interests in the construction of harbors, levees, and terminals at various points along said river."

2. The St. Croix River is about 160 miles long, forms for the greater part of its length the boundary between Wisconsin and Minnesota, and empties into the Mississippi River at Prescott, Wis., 26.9 miles below St. Paul. The distance from the mouth to Taylors Falls is 52.3 miles. The lower 25.3 miles of the river is known as Lake St. Croix. There are situated on the reach under consideration six towns having a total population of about 17,000, of which Stillwater has 10,198.

3. The existing project, adopted by the river and harbor act of June 19, 1878, provides for improvement between the mouth and Taylors Falls by means of dredging, wing dams, and bank protection, in order to obtain a channel depth of 3 feet at mean low water, at an estimated cost, as last modified, of $136,700. The project was reported as completed in 1900. The amount expended to June 30, 1915, was $156,487.34, of which $25,077.84 was for maintenance. The controlling low-water depths above and below Stillwater are 2 feet and 4 feet, respectively.

4. The commerce of 1915 consisted of passenger and excursion traffic amounting to about 8,500 persons, and about 6,700 tons of lumber rafted out of the river. Logging operations have ceased and prospective commerce is principally in the excursion business, attracted by the beautiful scenery. A large number of logs have been recovered from the bed of the river, and it is proposed to continue this work under the existing project. No cooperation on the part of local interests in regard to the construction of harbors, levees, and terminals is offered at this time. The district officer is of opinion that the present project has sufficient scope to provide for all present needs of commerce and for the removal of logs, and he recommends that the locality be held unworthy of additional improvement. The division engineer recommends that improvement be limited to ordinary snagging in the steamboat channel.

5. Interested parties were informed of the unfavorable report of the district officer and given an opportunity of submitting statements and arguments to the board, but no communications on the subject have been received.

6. It appears from the information now available that aside from summer excursion business there is very little traffic on the river and that all reasonable demands will be met by keeping the channel clear of snags and logs. The board therefore concurs with the district officer and the division engineer, and reports that in its opinion it is not advisable for the United States to undertake the improvement of St. Croix River from its mouth to Taylors Falls to a greater extent than is authorized by the existing project.

7. In compliance with law, the board reports that there are no questions of terminal facilities, waterpower, or other related subjects which could be coordinated with the suggested improvement in such manner as to render the work advisable in the interests of commerce and navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF ST. CROIX RIVER, MINN. AND WIS.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
St. Paul, Minn., May 27, 1916.

From: The District Engineer Officer,
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of St. Croix River, Minn. and Wis.

1. Under the provisions of the River and Harbor act approved July 25, 1912, and in compliance with department letters of August 3, 1912, and February 26, 1916, the following report is submitted upon a preliminary examination of:

> St. Croix River, Minn., and Wis., from the mouth to Taylors Falls, with a view to the removal of logs and other obstructions, consideration being also given to the question of cooperation on the part of local interests in the construction of harbors, levees, and terminals at various points along said river.

2. *Description of the locality.*—The source of the St. Croix River is in northwestern Wisconsin, 21 miles from Lake Superior, and approximately 1,010 feet above sea level. The river is about 160 miles long, drains an area of 7,290 square miles, flows southwesterly and then southerly, forming for the greater part of its length the boundary between Wisconsin and Minnesota. It flows into the Mississippi River at Prescott, Wis., 26.9 miles below St. Paul, Minn. The lower 25.3 miles of the river is known as Lake St. Croix. At Taylors Falls, Minn., the river has a low-water discharge of about 1,200 second-feet and an extreme high-water discharge of about 36,000 second-feet.

From Taylors Falls to the head of Lake St. Croix (27 miles) the bluffs rise steeply on either side of the river to a height of 150 to 200 feet. In this stretch the river has a fall of about 0.7 foot per mile and a width of 130 to 800 feet. Lake St. Croix is 25.3 miles long, nearly level, and from 1,500 to 6,500 feet wide.

The principal tributaries below Taylors Falls are the Apple River, 55 miles long, and Willow River, 35 miles long.

The larger towns and population (1910 census) are: St. Croix Falls, Wis., 700; Taylors Falls, Minn, 454; Osceola, Wis., 925; Stillwater, Minn., 10,198; South Stillwater, Minn, 1,343; Hudson, Wis., 3,220; and Prescott, Wis., 936.

3. *Previous reports.*—Documents containing previous reports bearing on the St. Croix River are:

(*a*) House Document No. 58, Thirty-ninth Congress, second session. Surveys of the upper Mississippi River and its tributaries. General report on navigation improvements required between St. Paul, Minn., and St. Louis, Mo., including practicability of bridging. No special improvement thought necessary on the St. Croix River.

(*b*) House Document No. 247, Fortieth Congress, second session. Survey and improvement of the upper Mississippi River and tributaries. Includes estimate of $5,000 for surveys of, and $5,000 for removing obstructions in the St. Croix River.

(*c*) House Document No. 75, Part 6, Forty-third Congress, second session.[1] Examinations of the St. Croix and Chippewa Rivers. Estimate of improvement required for a 3-foot channel at low water, including brush dams, one wing dam, and removal of obstructions, $21,758.

(*d*) House Document No. 54, Forty-fifth Congress, third session. Sources of Mississippi, St. Croix, Chippewa, and Wisconsin Rivers, for reservoirs. Includes report of examination of the sources of the St. Croix River, for reservoirs.

(*e*) House Document No. 39, Forty-sixth Congress, second session. Examination and survey, Headwaters of the Mississippi, St. Croix, Chippewa, and Wisconsin Rivers, for reservoirs—progress report. Estimate of cost of reservoir dams at headwaters of St. Croix River, $437,042.30.

(*f*) House Document No. 40, Forty-sixth Congress, second session. Survey from Taylors Falls to Prescott. Estimated cost for dams, jetties, shore protection, dredging, and removing obstructions, $60,250.

(*g*) House Document No. 268, Fifty-first Congress, second session. Preliminary examination of harbor at Hudson, Wis., with a view to preventing the city from being cut off from the navigable channel of St. Croix Lake, and with a view of conducting the waters of Willow River past the city of Hudson. Report unfavorable.

(*h*) House Document No. 104, Fifth-sixth Congress, first session. Preliminary examination of St. Croix River, from Stillwater Harbor to Taylors Falls, with a view to making river accessible to steamboats and other craft. Recommends $1,000 per year for maintenance.

(*i*) House Document No. 686, Fifth-ninth Congress, first session. Taylors Falls to the mouth. Preliminary examination with a view to increasing the channel depth to 4 feet. District officer recommends survey at estimated cost of $3,000. Board of Engineers for Rivers and Harbors decide survey not justified, but favorable to annual appropriation of $3,600 to maintain the 3-foot channel.

(*j*) House Document No. 422, Sixty-second Congress, second session. Preliminary examination for dredging at Afton, Minn. Report unfavorable.

(*k*) House Document No. 330, Fifty-fourth Congress, first session. Lake Superior and Mississippi River Canal. In the estimate of cost for a canal 7 feet deep from Lake Superior to the Mississippi River, via the St. Croix River, an item of $250,450 is given as the cost of dredging and constructing wing dams. Report unfavorable.

(*l*) House Document No. 69, Fifty-sixth Congress, first session. Lake Superior-Mississippi River Canal. Supplemental report. Report unfavorable.

(*m*) House Document No. 304, Sixty-first Congress, second session. Preliminary for canal connecting Lake Superior and the Mississippi River by way of the St. Croix River, Minn. and Wis. Report unfavorable.

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[1] Basis of project adopted by the river and harbor act of June 18, 1878.

4. *Work previously done.*—Work done under the project adopted by the river and harbor act of June 18, 1878, consisted of dredging approximately 84,000 cubic yards, the construction of approximately 19,000 linear feet of wing dams and bank protection, and the removal of about 14,000 snags, stumps, and logs. The project is considered as having been completed in 1900. No work has been done on the river since 1911. The expenditures to June 30, 1915, were $131,409.50 for new work, and $25,077.84 for maintenance, a total of $156,487.34.

The city of Stillwater spent about $5,500 on a wall and levee 550 feet long in connection with the water front improvement.

5. *Navigable extent.*—The navigation season is from April 1 to October 31. The river is navigable from the mouth to Taylors Falls, Minn. Above Stillwater the controlling depths at low, mean, and high stages, and months in which such stages may be expected are: Low stages, 2 feet, in July, August, September, and October; mean stages, 4 feet, in July, August, September, and October; high stages, 6 feet, in April, May, and June. Below Stillwater the controlling depth is about 4 feet at mean low water on the bar at Hudson.

The fluctuation of water surface from mean low water to mean high water is about 10 feet at Stillwater and 7.3 feet at Osceola.

6. *Channel.*—The least head room at any fixed bridge is at the highway bridge at Hudson, being 50.8 feet above mean high water. The telephone line at Stillwater has a vertical clearance of 43.4 feet above mean high water.

The least available channel width is at the Minneapolis, St. Paul & Sault Ste. Marie Railway bridge, 4.3 miles below Osceola, being 102 feet.

7. *Navigation difficulties.*—Navigation has been interfered with by deadhead logs, the manipulation of the flow by the water-power company at St. Croix Falls, and during low water by sand bars above Stillwater.

8. *Waterways of approach.*—The waterway of approach is the Mississippi River, with an available depth of 6 feet at mean low water.

9. *Present and prospective commerce.*—The present commerce consists of excursion boats, launches, rowboats, and canoes. Two excursion boats of about 20 tons each have lately been built for use on the St. Croix River. One is intended for use in making daily trips from Stillwater to Taylors Falls. During the season of 1915 about 8,500 passengers were carried on the St. Croix, and a small amount of lumber and lath was rafted out of the river from Hudson. Lumber, 6,726 short tons, value $134,530; Lath, 446 short tons, value $6,471. One boat on its weekly trip from St. Paul to Davenport, Iowa, makes a side trip up the St. Croix to Stillwater.

The prospective commerce in the immediate future is the continuation of the passenger business, the St. Croix Valley being celebrated for its beautiful scenery. The lumber interests on the river itself, as far as the floating of logs is concerned, is little, and practically no more rafting will be done. A small amount of commerce may be in the handling of potatoes and grain, but this will probably be taken care of by the passenger boats plying on the river. Should the barge traffic on the Mississippi River prove financially feasible, shipments of lumber to this locality from Southern States could be made, and potatoes and large quantities of trap rock from the vicinity of Taylors Falls could be shipped to the south. However, this will require larger barges than can be accommodated on the St. Croix River under the existing project.

10. *Terminals.*—No suitable terminals or transfer facilities have been provided for in the St. Croix Valley other than a landing for excursion boats at Stillwater, Minn. At this point ample space is available for larger terminals for excursion and freight business.

11. *Water power.*—About a mile above the bridge at Taylors Falls, the head of navigation, is a power dam, operated by the Minneapolis General Electric Co., of Minneapolis, Minn. The installation consists of six 2,500-kilowatt generators. It has been in operation since 1907. About 10 miles above is Nevers Dam, formerly a logging dam, but now used for storage in connection with the power dam. During low-water periods the manipulation of the flow caused much inconvenience to the boating interests.

12. *Discussion.*—At a public hearing held at Stillwater, Minn., on April 27, 1916, in connection with this examination, the subject was thoroughly discussed. Representatives of Stillwater, South Stillwater, Marine Mills, Taylors Falls, the Interstate Park, the Minneapolis General Electric Co., and boating interests were present. It was developed that the present project covers the requirements of such navigation as now exists.

Since the river and harbor bill calling for this examination was passed logging operations on the St. Croix River have ceased. Formerly when the logs were floated down the stream, large numbers were left in the channel and on the banks, which resulted in innumerable sunken logs and deadheads, becoming obstructions to navigation. During the past two years more than 2,000,000 feet b. m. of lumber has been sawed from logs recovered from the bed of the stream. This work has eliminated the greater portion of the obstructions of this nature. The work of removal will continue during the coming season.

Another difficulty has been the fluctuation of water level caused by the operation of the dam at St. Croix Falls, which has resulted in a very unsatisfactory condition, especially during low-water periods. The former regulations of the discharge from this dam required only 1,200 cubic feet per second when the natural flow was greater than this amount, and when less than 1,200 cubic feet per second only two-thirds of the natural flow was required.

The operations of the power company which controls this water were such that even in the low-water periods an average of more than 2,000 cubic feet per second during the week was generally used, whereas on Sundays and holidays the discharge was reduced, often to only 800 cubic feet per second, as they did not need the power on those days. The greater portion of the traffic on the river being on Sundays and holidays, it was apparent that the interests of the power company and those of navigation were not in harmony, and many complaints followed. This resulted in a modification of the regulations in the latter part of 1915. The new regulations require a flow of 2,000 cubic feet per second at all times except that when the natural flow is less than that amount, the full natural flow must pass. These regulations are expected to improve conditions considerably.

The various interests along the river are desirous of having harbors, levees, and terminals which will permit large barges and boats to operate. However, no cooperation will be forthcoming until some future time when boat lines shall have been established on the Mississippi River and the transportation companies have evidence that their investment is profitable.

The consensus of opinion as gathered by the district officer at the public hearing seemed to be that the passenger and local freight that could be carried on excursion steamers should be protected, and that the harbor facilities necessary to carry on this class of traffic would be promptly provided by the towns interested.

It is my opinion that the present project has sufficient scope to provide for all the present needs of commerce and for the removal of such logs as may still remain obstructions to navigation.

13. *Recommendation.*—In view of the fact that the logs are no longer a great hindrance to navigation, those remaining can be removed under the existing project. As the localities are interested at present only in passenger traffic and such freight traffic as can be carried on light-draft excursion boats, for which they will provide proper terminal levees and facilities, it is recommended that the locality be held unworthy of improvement by the United States, for the purpose of cooperation in the construction of harbors, levees, and terminals.

E. D. Peek,
Major, Corps of Engineers.

[First indorsement.]

Office Division Engineer, Western Division,
St. Louis, Mo., June 3, 1916.

To the Chief of Engineers, United States Army:

1. Forwarded, recommending that the improvement of the St. Croix River be limited to ordinary snagging in the steamboat channel.

2. Harbors, levees, and terminals are local improvements, which should be paid for entirely by local interests.

C. McD. Townsend,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors, see p. 3.]

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64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1700.

HARBOR OF REFUGE AT HARBOR BEACH, MICH.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON REEXAMINATION OF HARBOR OF REFUGE AT HARBOR BEACH, MICH.

DECEMBER 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 6, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated September 21, 1916, submitting a report from Col. M. M. Patrick, Corps of Engineers, dated May 17, 1916, with map, and report from Maj. H. Burgess, Corps of Engineers, dated July 17, 1916, relative to the project for improvement of the harbor of refuge at Harbor Beach, Mich., made by them in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

NEWTON D. BAKER,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, September 21, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of harbor refuge at Harbor Beach, Mich.

1. Under authority contained in section 14 of the river and harbor act approved March 4, 1915, there is submitted herewith, for transmission to Congress, report dated May 17, 1916, with map, by Col. M. M. Patrick, Corps of Engineers, and report dated July 17, 1916,

by Maj. H. Burgess, Corps of Engineers, relative to the project for improvement of the harbor of refuge at Harbor Beach, Mich.

2. Harbor Beach is an artificial harbor located on the west shore of Lake Huron, about 60 miles north of the city of Port Huron. Its construction was authorized by the river and harbor act of March 3, 1871, and the plan subsequently approved provided for breakwaters having an aggregate length of 7,000 feet, at an estimated cost of $1,452,550. Since 1907 maintenance and renewal of the breakwaters have been carried on in general conformity with the recommendations contained in a report submitted under authority of the act of March 3, 1905, and printed in House Document No. 900, Fifty-ninth Congress, first session. The deepening of the harbor and main entrance and the closing of the north entrance, contemplated by that report, however, have not been undertaken. The district officer states that there has been considerable shoaling near the north entrance and that if this entrance be closed the maintenance of the harbor will be much easier and less expensive. To fit the harbor for use by large vessels navigating the Lakes, he recommends that the north entrance be closed, that the main entrance be dredged to a depth of 25 feet, and that the area shown on the map be dredged to a depth of 23 feet, referred to a datum plane 579 feet above mean tide at New York, at a total estimated cost of $425,000. The division engineer recommends that the north entrance be closed, that the main entrance be deepened to 23 feet and the harbor basin area to 21 feet at low water, elevation 579.6 above mean tide at New York, at a total estimated cost of $206,000. The Board of Engineers for Rivers and Harbors concurs in the views of the division engineer.

3. After due consideration of the above-mentioned reports, I concur in the views of the division engineer and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing a modification of the existing project for the harbor of refuge at Harbor Beach, Mich., so as to provide for closing the north entrance, dredging the main entrance to a depth of 23 feet and the anchorage area as marked on the accompanying map to 21 feet, referred to elevation 579.6 above mean tide at New York, at a total estimated cost of $206,000, and $10,000 annually thereafter for maintenance. The full amount of the estimate should be made available in one appropriation.

W. M. BLACK,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
August 8, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. This report on harbor of refuge at Harbor Beach, Mich., is submitted under authority of that portion of section 14 of the act of March 4, 1915, which reads "and the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. A project for the construction of this harbor was adopted in 1871. It provided for three breakwater piers of cribwork filled with stone, sheltering an area of about 650 acres, and for deepening this area where necessary. The estimated cost of the breakwaters was $1,452,550, but they were completed in 1885 at a cost of about $970,000, including maintenance to that date. No dredging was done.

3. Under authority of the act of 1905, a report was submitted covering such further works as were considered necessary in order to make the harbor suitable for the demands of commerce. It proposed (1) renewing the superstructures of the piers with concrete, (2) protecting the outer face of the main pier with riprap, (3) dredging an area of 200 acres in the harbor to a depth of 21 feet and of the main entrance to 23 feet, (4) closing the north entrance, all at an estimated cost of $970,000, and $20,000 annually for maintenance. Work of maintenance under the project has been carried on since 1907 in conformity with items (1) and (2). The superstructure of the north breakwater, the main breakwater, and a portion of the south breakwater have been replaced and some of the riprapping done. The total amount expended on the harbor to June 30, 1915, was approximately $2,020,000. Considerable damage to the main breakwater was done by the storm of 1913, after which an estimate was submitted covering the necessary repairs to the main breakwater, riprapping it, and completing the concrete superstructure of the south breakwater, the amount being $362,380. Of this amount $200,000 was allotted from the appropriation of 1915. With the balance to be appropriated ($162,380) all work contemplated by the 1905 report will have been accomplished except the closing of the north entrance and the dredging.

4. A recent survey made to determine present conditions shows that material shoaling has taken place in the harbor, particularly near the north entrance. The district officer states that this entrance is used but little and that if it be closed the maintenance of the proper depth will be much easier and less expensive. A depth of only about 19 feet can be carried through the main entrance, and this is about the draft of the larger freighters. The area within the harbor having a depth of 19 feet and over is only about 72 acres. To fit the harbor for the uses for which it was intended, the district officer recommends that the north entrance be closed, that the main entrance be dredged to a depth of 25 feet, and that the area shown on the map be dredged to a depth of 23 feet, referred to a datum plane 579 feet above mean tide at New York, at a total estimated cost of $425,000. Annual maintenance thereafter is estimated at $10,000. In his indorsement of May 23, 1916, the division engineer concurs generally in the above recommendation, but in his indorsement of July 20, 1916, on a supplemental report, he recommends a depth of 23 feet in the main entrance and 21 feet in the harbor basin referred to elevation 579.6 feet above mean tide at New York, 2 feet below mean lake level, 1860–1875. On this basis the estimate for the dredging is $156,000.

5. The information now in hand shows that considerable shoaling is caused by material which drifts through the north entrance, that the depth in the main entrance is not sufficient in time of storm for the larger vessels that may be expected to seek refuge at such times, and that the anchorage area for such vessels is inadequate. The

board therefore concurs with the district officer and the division engineer as to the advisability of modifying the existing project, so that it will meet present requirements. It believes that the north entrance should be closed, as recommended by the district officer and the division engineer, and it agrees with the division engineer as to the depth that should be provided. In view of the foregoing the board recommends legislation authorizing the modification of the existing project for harbor of refuge at Harbor Beach, Mich., so as to provide for closing the north entrance, dredging the main entrance to a depth of 23 feet and the anchorage area as marked on the accompanying map to 21 feet, referred to elevation 579.6 above mean tide at New York, at a total estimated cost of $205,000, and $10,000 annually thereafter for maintenance. The full amount of the estimate should be made available in one appropriation.

For the board:

H. C. Newcomer,
Colonel, Corps of Engineers,
Senior Member Present.

REEXAMINATION OF HARBOR OF REFUGE AT HARBOR BEACH, MICH.

War Department,
United States Engineer Office,
Detroit, Mich., May 17, 1916.

From: The District Engineer Officer.
To: Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Modification or abandonment of project, harbor of refuge at Harbor Beach, Mich.

1. In compliance with the directions contained in the fourth indorsement, office of Chief of Engineers, May 3, 1915, the following report is submitted upon the advisability of modifying or abandoning the present project for improving harbor of refuge at Harbor Beach, Mich.

2. The harbor of refuge at Harbor Beach, Mich., lies on the west shore of Lake Huron, 60 miles north of its outlet into the St. Clair River and is the only safe refuge on that coast from the foot of the lake to Tawas Bay, 115 miles above. The locality is shown on Lake Survey Chart No. 51.

3. Reference to examination or survey reports and maps or plans are made in the Annual Reports of the Chief of Engineers, 1872,[1] pages 209 to 213 and 217 to 222; 1873,[2] pages 292 to 295; and 1906,[1] page 664; also in House Document No. 900,[3] Fifty-ninth Congress, first session.

4. The construction of a harbor of refuge on Lake Huron was adopted by the river and harbor act of March 3, 1871. The location of the harbor at Sand Beach (now known as Harbor Beach) and a plan for its construction were recommended by a board of engineer

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[1] No maps.
[2] Basis of project adopted by Congress—contains no maps.
[3] Contains maps.

officers in a report dated October 12, 1872, which was approved by the Secretary of War March 14, 1873. This plan provided for the construction of breakwaters with an aggregate length of 7,000 feet at an estimated cost of $1,452,550, and left the matter of providing an entrance in the northern portion of the breakwater to be decided later. The breakwaters were of the usual crib construction. The work was begun in 1873 and finished in 1885. The breakwaters as completed consisted of the north breakwater 1,505 feet long, running east and west, separated from the main breakwater by the north entrance, 300 feet wide; of the main breakwater, 4,716 feet long, running east and west to the first angle and northwest and southeast therefrom to the second angle and north and south from this point, separated from the south breakwater by the main entrance, 600 feet wide; and of the south breakwater, 1,956 feet long, running due north and south. Between the lower end of the south breakwater and the shore, 2,200 feet, the water is very shoal. The area inclosed is about 650 acres and the deepening of this sheltered area where necessary was authorized by the river and harbor act of August 2, 1882, and subsequent acts of Congress.

5. The river and harbor act of 1905 directed an examination of this harbor "with a view to ascertaining what other or further works of improvement are necessary, if any," in order to make it suitable for the demands of commerce. This report (H. Doc. No. 900, 59th Cong., 1st sess.), recommended (1) completing renewing with concrete the superstructures of the piers, (2) protecting by riprap the outer face of the main pier, (3) dredging an area of 200 acres in the harbor to a depth of 21 feet and the main entrance to 23 feet, (4) closing the north entrance. The estimated cost of this work was $970,000, with $20,000 annually for maintenance. Since 1907 the work of maintenance has been carried on in conformity with the recommendations contained in this report. Prior to 1907 the reconstruction in concrete of the superstructure of the main pier was begun and prosecuted under two contracts which covered the completion of 3,542 linear feet of this superstructure. The act of March 2, 1907, provided $150,000 for "continuing improvement and for maintenance." The crib superstructures of the remaining portion (1,174 feet) of the main breakwater, of the north breakwater, and of a portion of the south breakwater have been replaced with concrete and the remainder of this part of the work is now under contract. Some riprapping of the outer face of the main breakwater was done with the small stone from the portions of the cribs removed to make place for the new superstructure, but the slope originally given this riprap was flattened by wave action, and by 1913 this pile of riprap had been reduced to a layer of stone on the bottom apparently only about 4 or 5 feet thick next to the pier. A contract is now in force for riprapping a portion of this breakwater. The north entrance has not been closed, and none of the dredging contemplated in the report above referred to has been done.

6. The great storm of November, 1913, washed out some of the filling of the crib substructure of the main breakwater, permitting the concrete superstructure to settle and breaking many of the concrete blocks. This damage occurred for a length of about 1,150 feet near the north entrance and for about 300 feet near the southern

end, damaging all told 56 superstructure blocks. After this storm an estimate was submitted covering the cost of riprapping the main breakwater, of repairing the damage done to its superstructure, and of completing the concrete superstructure of the south pier, all at a total cost of $362,380. Of this amount the sum of $200,000 was provided from the funds made available by the act of March 4, 1915, and contracts have been made for riprapping along the damaged part of the main breakwater and for building the concrete superstructure of the south breakwater. It is assumed that funds will be made available to provide for carrying out the remainder of the work covered by this estimate. When all this is done, of the work recommended in 1905, there will remain the closing of the north entrance and the dredging.

7. There are very few natural harbors on the west shore of Lake Huron, and this artificial harbor at Harbor Beach was primarily intended to provide shelter for lake vessels in stormy weather. The reports published in House Document No. 900, Fifty-ninth Congress, first session, discussed at length the conditions existing about 1905, and the changes which had taken place in the character of the vessels plying these waters during the previous 20 years. The tendency toward longer and larger freight vessels then noted has continued to manifest itself during the last decade. The statistics compiled at St. Marys Falls Canal give in 1904 but 1 vessel on the Lakes 500 feet long, while in 1915 there were 116 vessels between 500 and 600 feet long, and 29 vessels over 600 feet long. It has become more and more rare to see a sailing vessel carrying freight. On the other hand the number of small boats propelled by gasoline engines and used for freight and pleasure purposes has increased greatly.

8. The practical disappearance of sailing freighters and the remarkable increase in the size of steam freighters have somewhat diminished the importance of this harbor, although it must be pointed out that conditions at the entrance and within the harbor did not favor its use by vessels of the largest classes, even if they had wished to seek its shelter during storms. During the calendar year 1914, 309 vessels (aggregate tonnage, 212,582 tons), and during 1915, 358 vessels (aggregate tonnage, 240,847 tons), and during these two years 61 motor boats sought shelter from storms in this harbor.

9. In addition to this use of the harbor, the local freight movement to and from the town of Harbor Beach, located on the harbor, in 1915 amounted to 18,645 tons, valued at $359,908, and the landing of these freight steamers at the local dock was made easier by reason of the existence of the breakwaters.

10. It is thought probable that small boats in still greater numbers will use this harbor in the future and that the largest boats would likewise enter it for shelter if conditions were such that they could do so. The storm of November, 1913, indicated the necessity for even the largest vessels to take shelter at such times.

11. At lake level, 579 feet above mean tide New York, only about 19 feet can be carried through the main entrance into the harbor. The larger freighters now load to over 19 feet. The area within the harbor with depths of 19 feet and over is only about 72 acres. It is evident that the entrance depth and the available area within the harbor are insufficient to permit the larger vessels to find shelter

here in stormy weather. The original project and the reports contained in House Document No. 900, Fifty-ninth Congress, first session, all covered dredging at the harbor entrance and within the harbor to the extent necessary to meet the demands of commerce and it is now evident that under present conditions dredging must be carried to a greater depth than has been contemplated heretofore in order that the legitimate demands of existing commerce may be fully met.

12. In House Document No. 900, Fifty-ninth Congress, first session, the Board of Engineers for Rivers and Harbors recommended that the north entrance to this harbor be closed because of the expected shoaling within the harbor if it were left open. A survey through the ice was made during February, 1916, to ascertain existing conditions in the harbor. When the results of this survey are compared with those of the survey made in 1905 it becomes evident that the total shoaling within the area inside the harbor covered by both surveys was about 224,400 cubic yards, bank measure. This shoaling was greater near the entrances to the harbor than elsewhere and much greater near the north entrance than near the main entrance. It is evident that the shoaling expected if the north entrance remained open is an accomplished fact. This north entrance is very rarely used and the closing of it will not seriously interfere with navigation, while if it be closed the maintenance of the proper depth within the harbor will be much easier and less expensive.

13. It is therefore recommended (1) that the north entrance to this harbor be closed, (2) that the main entrance to the harbor be dredged to a depth of 25 feet, and that the area shown on the map herewith, within which the depth is not greater than about 19 feet at low water, be dredged to a depth of 23 feet, these depths to be referred to a datum plane which is 579 feet above mean tide, New York. This dredging will require the removal of approximately 500,000 cubic yards, bank measure. Of this total amount 115,000 cubic yards is due to shoaling during the past 11 years. The undisturbed bottom of the harbor is known to be composed partly of hardpan with possibly some rock and its dredging will be difficult. Furthermore, this harbor bottom when dredged will afford very poor holding ground for anchors. Mooring posts have been provided at intervals along the berm of the main breakwater, and vessels which take shelter within this harbor must swing to these mooring posts. Vessels which attempted to lie along the breakwater during the 1913 storm found it impossible to do so on account of the great volume of water which came over it. The area which it is proposed to dredge to a depth of 23 feet will be about 1,200 feet wide along the inner side of the main breakwater, and this is believed to be sufficient to enable the longest vessels at present in use to ride safely during storms, although it is possible that it may be necessary later to provide stern moorings at intervals along the inner edge of this dredged area.

14. The cost of the work recommended above is estimated as follows:

Closing north entrance	$50,000
Dredging 500,000 cubic yards, bank measure, at 75 cents	375,000

It is further estimated that the maintenance of this harbor will cost $10,000 per year.

15. Within this harbor there is but one dock and this belongs to private parties. The privileges of this dock are understood to be extended to all vessels on like terms. There is no public space available for building public wharves. On the existing private dock there are derricks for loading and unloading boats and there is a spur track which leads from this dock to the main line of the railroad, although this connection is used but little.

16. The improvement of this harbor involves no question of the development of water power.

Mason M. Patrick,
Colonel, Corps of Engineers.

[First indorsement.]

Office Division Engineer Lakes Division,
Buffalo, N. Y., May 23, 1916.

To the Chief of Engineers, United States Army:

1. Forwarded.

2. I concur in the recommendation in paragraph 13 of the district officer's report that the project for harbor of refuge at Harbor Beach, Mich., be modified to provide that the north entrance be closed, and that the main harbor entrance be dredged to a depth of 25 feet at low water, and that the part of the harbor basin (as shown on the map with the district officer's report) be dredged to a depth of 23 feet at low water at an estimated cost of $425,000 for new work and $10,000 for annual maintenance.

3. I further recommend that the plane of low water be that recommended by me in report to the Chief of Engineers, dated December 13, 1915, on "Uniformity of datum planes," viz, 579.6 feet above mean tide at New York, 2 feet below mean lake level 1860–75.

J. G. Warren,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors, see p. 2.]

SUPPLEMENTAL REPORT ON REEXAMINATION OF HARBOR OF REFUGE AT HARBOR BEACH, MICH.

War Department,
United States Engineer Office,
Detroit, Mich., July 17, 1916.

From: The District Engineer Officer.
To: Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Modification of project, harbor of refuge, Harbor Beach, Mich.

1. In compliance with the instructions of the Chief of Engineers, dated June 9, 1916, I submit the following report, containing the additional information requested by the Board of Engineers for Rivers and Harbors relative to harbor of refuge at Harbor Beach, Lake Huron, Mich.

2. The estimates given in Col. Patrick's report of August 2, 1915, were obtained from existing maps prepared from former surveys,

and he called attention to the desirability of making a new survey to determine the amount of excavation required for the improvement. This survey was made in February, 1916, and it showed that during the interim between those surveys shoaling had taken place in the area to be dredged amounting to about 115,000 cubic yards. This extensive shoaling accounts for the increase in amount of dredging recommended, and, as may be noted from the report of May 17, 1916, also for the recommended closure of the north entrance. A careful examination of the record of borings formerly made in the harbor indicated the desirability of an increase in estimated unit cost for the dredging. Blue prints[1] of this record are attached.

3. The datum plane to which depths were referred in computing the quantity of excavation is a Lake Huron stage of 579, or about 2.6 feet below the mean stage for the years 1860–1875 (2 feet below mean stage 1860–1915). For a Lake Huron stage of 579.6 the amount of material to be removed for the purpose of giving 23 feet depth in the entrance and 21 feet in the anchorage area is about 240,000 cubic yards; and for these depths the unit cost may be assumed to be about 65 cents. The cost of such dredging may, therefore, be taken at about $156,000.

4. Under conditions which prevail at times when it becomes necessary for vessels to seek a harbor of refuge, a considerable margin of depth over draft is required in order to prevent boats striking the bottom. A vessel of 19-foot draft could not safely enter Harbor Beach while heavy seas are running, if the entrance be dredged to less depth than the 25 feet recommended by Col. Patrick; and this is particularly true if the storm occurs during a low-water period in the lake. Under conditions now existing this harbor can not be considered a harbor of refuge for the larger vessels navigating the lake, and the fact that none are reported to have used it would have little bearing on the question of the desirability of dredging over the areas and to the depths recommended in Col. Patrick's report of May 17, 1916. The question arises, however, as to whether or not a harbor of refuge is necessary at this location suitable for all classes of vessels navigating the lakes. It is believed that the report of May 17 was based on a careful investigation of this question, and there is on file in this office considerable correspondence from navigation interests which shows a desire to have this harbor improved so as to make it available for the larger vessels. Canadian officials have transmitted a portion of this correspondence and have indicated their view that the improvement of the harbor would be of great benefit to Canadian vessels.

5. The draft of vessels entering the harbor is not known. Since 1910 vessels of 17-foot draft have at times grounded within the harbor, and this has tended to discourage attempts to make use of it except by the smaller vessels. The following statement shows the number of vessels entering the harbor annually since 1906:

1906	954	1911	693
1907	887	1912	615
1908	703	1913	515
1909	827	1914	606
1910	860	1915	841

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[1] Not printed.

6. The number of vessels lost or damaged in the storm of November 9 to 11, 1913, is indicated in the following table, the number of lives lost being 178:

Name of vessel.	Length.	Beam.	Net tonnage.	Gross tonnage.	Carrying capacity.
	Feet.	*Feet.*			*Gross tons.*
Charles S. Price	504	54	4,901	6,322	9,000
Isaac M. Scott	504	54	4,840	6,372	9,000
John A. McGean	432	52	3,777	5,100	7,500
Argus	416	50	3,380	4,707	7,000
Hydrus	416	50	3,384	4,713	7,000
James Caruthers[1]					9,500
Wexford[1]					2,800
Regina[1]					3,000
VESSELS STRANDED, CONSTRUCTIVE TOTAL LOSS.					
H. M. Hanna, jr	480	54	4,413	5,905	8,500
Matoa	290.6	40.5	1,836	2,311	3,100
VESSELS SERIOUSLY DAMAGED.					
Northern Queen	299.5	40.8	1,885	2,476	
H. B. Hawgood	414	50	3,386	4,655	6,200
Mathew Andrews	532	56	5,497	7,014	10,000
D. O. Mills[2]	532	58.2	4,850	6,598	10,000
H. W. Smith	414	50	3,415	4,662	6,200

[1] Canadian.

[2] The steamer D. O. Mills went ashore in the vicinity of Harbor Beach.

7. The area to be dredged for anchorage within the harbor seems to be as restricted as can safely be provided for, if the harbor is to serve for the larger class of vessels. The necessity for larger vessels seeking this harbor will occur only rarely, but when it becomes advisable for vessels to seek refuge here, all which are within reach will undoubtedly attempt to enter. It can not be anticipated how many vessels the dredged anchorage area will be called upon to accommodate, but in a storm they can not be berthed at such close intervals as would be practicable if vessels entered the harbor during calm weather. For vessels of less than 17-foot draft it is probable that no further improvement would be necessary at this harbor, except the closure of the north entrance for the purpose of preventing additional shoaling. For 17-foot draft the dredged area might reasonably be reduced and the depth of dredging be confined to 23 feet at entrance and 21 feet within the harbor; but for 19-foot draft both the area and the depths recommended by Col. Patrick are believed to be necessary. That is, if this harbor of refuge is to be considered as available for all classes of lake vessels, the entrance should be dredged to 25 feet depth and the area within the harbor to a depth of 23 feet within the limits shown on the map accompanying the report of May 17, 1916.

H. Burgess,
Major, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, LAKES DIVISION,
Buffalo, N. Y., July 20, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

The requirements for the harbor at Harbor Beach are regarded to be no greater, as to depth, than those at Buffalo Harbor, and therefore, as an amendment of my recommendation in paragraph 2, first indorsement on the district officer's report of May 17, 1916, it is now recommended—

(1) That the north entrance to the harbor be closed; estimated cost $50,000.

(2) That the main entrance be deepened to 23 feet and the harbor basin area to 21 feet, at low water; elevation 579.6, 2 feet below mean lake level 1860–1875; estimated cost $156,000 (par. 3 of the district officer's letter) for areas shown on map with report of May 17, 1916; total estimated cost (1) and (2), $206,000.

(3) Annual maintenance, $10,000.

J. G. WARREN,
Colonel, Corps of Engineers.

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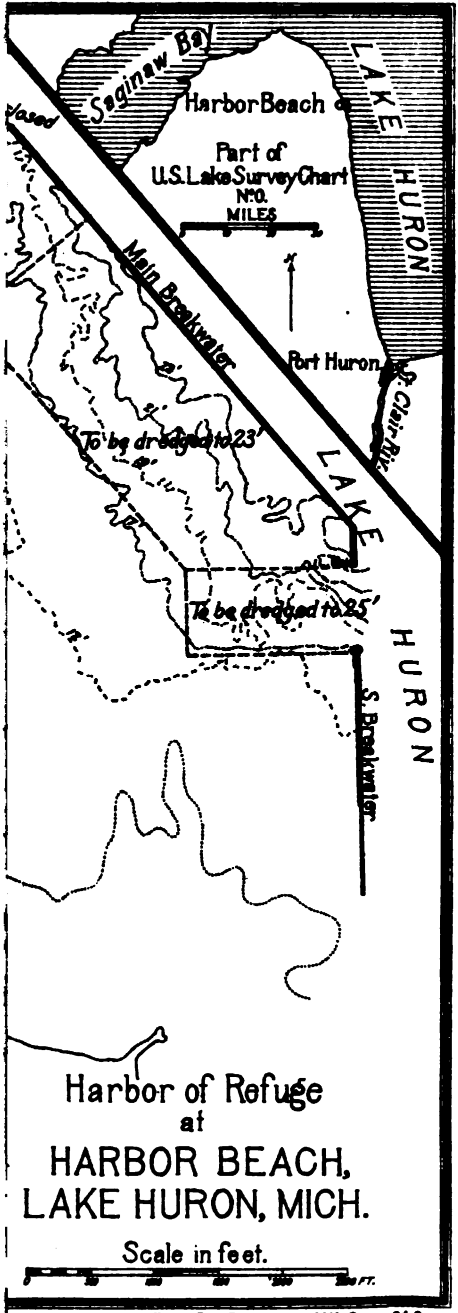

Harbor of Refuge
at
HARBOR BEACH,
LAKE HURON, MICH.

Scale in feet.

64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1701.

COOS BAY AND BAR ENTRANCE, OREGON.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF COOS BAY AND BAR ENTRANCE, OREGON, INCLUDING CONSIDERATION OF ANY PROPOSITION FOR COOPERATION ON THE PART OF LOCAL INTERESTS.

DECEMBER 9, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 6, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated October 17, 1916, submitting a report from Capt. (now Major) H. H. Robert, Corps of Engineers, dated September 24, 1912, and report from Maj. (now Lieut. Col.) J. J. Morrow, Corps of Engineers, dated December 26, 1914, with map, on a preliminary examination and survey, respectively, of Coos Bay and Bar entrance, Oregon, made by them in compliance with the provisions of the river and harbor act approved July 25, 1912.

Very respectfully,

NEWTON D. BAKER,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, October 17, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Coos Bay and Bar entrance, Oregon.

1. There are submitted herewith for transmission to Congress report dated September 24, 1912, by Capt. (now Maj.) H. H. Robert, Corps of Engineers, and report dated December 26, 1914, with map, by Maj. (now Lieut. Col.) J. J. Morrow, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act of July 25, 1912, of Coos Bay and Bar entrance, Oregon, "including consideration of any proposition for cooperation on the part of local interests."

2. Coos Bay is situated on the Pacific coast, about 180 miles south of the Columbia River and 445 miles north of San Francisco Bay. Under a project adopted in 1879 a north jetty 9,520 feet long was constructed, resulting in a depth across the bar of 20 feet at mean lower low tide. The existing project, adopted by the river and harbor act approved June 25, 1910, provides for securing such additional depth on the ocean bar as can be obtained and maintained by the construction and operation of a seagoing hydraulic dredge, and for dredging the bay channels between the bar and the town of Marshfield, 13 miles, with a view to securing a depth of 18 feet at mean lower low water and a width of 300 feet opposite the towns of North Bend and Marshfield and 200 feet at other points, at an estimated first cost of $500,000 and $60,000 annually for maintenance. The heavy seas have beaten down the outer portion of the jetty, but the district officer states that the structure is doing good work in the maintenance of the bar channel. He believes that it would be still more effective if repaired, and submits a plan of improvement involving the restoration of the jetty at an estimated cost of $1,000,000 and the operation of the dredge at an annual cost of $60,000. He believes that this plan will give a channel of at least 24 feet depth at low water, and expresses the opinion that the locality is worthy of further improvement to this extent without cooperation on the part of local interests, except the maintenance of the channels in the inner harbor, which the port of Coos Bay has offered to assume. In his report of December 30, 1914, the division engineer recommended that decision regarding the restoration of the jetty be deferred until after a thorough test of dredging had been made under the existing project.

3. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 25, 1916. Since the submission of the district officer's report several surveys have been made to determine the effect of dredging operations, and the results have been carefully considered by the board. There is now a channel about 400 feet wide and 25 feet deep at mean lower low water across the bar, which is an increase of about 5 feet in depth and some increase in width over the dimensions existing when dredging operations were undertaken. In view of the good results obtained by dredging,

the board reports that in its opinion no further work on the jetty is advisable at present, and it recommends that an adequate depth over the bar be secured by dredging, as provided for by the existing project.

4. After due consideration of the above-mentioned reports I concur in the views of the division engineer and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of the entrance to Coos Bay is not deemed advisable at the present time to a greater extent than is authorized by the existing project. The improvement of the bay channel will be reported upon separately under authority of the river and harbor act of March 4, 1915, which provides for an examination of this part of the improvement.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 25, 1916.

To the Chief of Engineers, United States Army:

1. The following is in review of the district officer's reports authorized by the river and harbor act of July 25, 1912, on preliminary examination and survey of Coos Bay and Bar entrance, Oreg., "including consideration of any proposition for cooperation on the part of local interests."

2. Coos Bay is located on the Pacific coast about 180 miles south of the Columbia River and 445 miles north of San Francisco Bay. Before improvement the controlling depth in the bar channel did not exceed at times 9 feet at mean lower low tide. The mean tidal range is 5.9 feet at the bar and 5½ feet at Marshfield, 13 miles above.

3. The existing project for Coos Bay and Harbor, adopted by the river and harbor act of June 25, 1910, provides for securing such additional depth on the ocean bar as can be obtained and maintained by the construction and operation of a seagoing hydraulic dredge and for dredging the bay channels between the bar and the town of Marshfield, 13 miles, with a view to securing a depth of 18 feet at mean lower low water and a width of 300 feet opposite the towns of North Bend and Marshfield and 200 feet at other points, at an estimated first cost of $500,000 and $60,000 annually for maintenance.

4. Under a previous project a north jetty 9,520 feet long was constructed, resulting in a depth of about 20 feet at mean lower low tide. The heavy seas have beaten down the enrockment, especially at the outer end, and at various places the jetty has subsided more or less, so that at high tide sand is carried over it into the channel.

5. Under the present project the 18-foot channel to Marshfield was completed in September, 1912; the dredge *Col. P. S. Michie* was completed in 1913; and the *Michie* has been operated since completion on the bar channel when funds were available and the condition of the dredge and of the weather would permit. The total amount ex-

pended on the present project to June 30, 1915, was $574,906.08, of which $512,518.33 was for new work and $51,287.75 for maintenance from United States funds and $11,100 for maintenance from funds contributed by local interests. The amount expended on all projects to June 30, 1915, was $1,544,703.35. In addition to the above work by the United States, local interests, under the direction of the port of Coos Bay, have been engaged in dredging the bay channel and have given it a general width of 300 feet and a depth of 25 feet, except on the rock shoal near Pigeon Point, opposite the inner end of the north jetty, at a total cost of nearly $600,000.

6. The commerce has been increasing in amount and value, and for the past three years has averaged about 467,000 tons, valued at $9,163,000. The commerce consists principally of lumber, although there is a large miscellaneous tonnage.

7. The district officer states that even in its present condition the jetty is doing good work in the maintenance of the bar channel. He believes that it would probably maintain a depth of 16 to 18 feet without the assistance of a dredge, and, if repaired, would be still more effective. It is thought, however, that an adequate channel would require the services of a dredge to supplement the work of the jetty. The district officer submits a plan of improvement involving the restoration of the jetty, at an estimated cost of $1,000,000, and the operation of the dredge, at an annual cost of $60,000. To this extent he believes the locality worthy of improvement. The division engineer is of opinion that a more extended trial of the dredging should be made before a final conclusion is reached as to the method of improvement best adapted to this locality. The board concurred with the division engineer and postponed action accordingly.

8. Since the above reports were submitted, over two and one-half years ago, dredging operations with the *Michie* have continued at irregular intervals. Several surveys have been made to determine the results of the dredging, the last one on June 1, 1916. While the dredge has not been able to make a continuous gain in channel capacity, the results, on the whole, have been very encouraging. The last report from the district officer, dated June 16, 1916, states there is now a channel about 400 feet wide and 25 feet deep at mean lower low water across the bar. This is an increase of about 5 feet in depth and some increase in width over the dimensions existing when dredging operations were undertaken. Moreover, the information now available indicates that even the existing favorable conditions may become better with the continued operation of the dredge and at a cost materially less than could be expected, through the reconstruction of the jetty and such auxiliary dredging as would be required. The work done by local interests inside the entrance has increased the dimensions of the bay channel, except on the rock shoal referred to above, to about those now existing on the bar. The need of additional improvement in the bay channel will be reported upon under authority of the river and harbor act of March 4, 1915, which provides specifically for an examination of this part of the improvement. In view of the good results obtained by dredging, the board reports that in its opinion no further work on the jetty is advisable at present, and recommends that an adequate depth over the bar be secured by dredging, as provided for under the present project.

9. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects which could be coordinated with the project proposed in such manner as to render the improvement advisable in the interests of commerce and navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF COOS BAY AND BAR ENTRANCE, OREGON.

UNITED STATES ENGINEER OFFICE, FIRST DISTRICT,
Portland, Oreg., September 24, 1912.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army.
Subject: Preliminary examination, Coos Bay and Bar entrance, Oregon.

1. Complying with instructions contained in letter from Office of Chief of Engineers, dated August 3, 1912, the following report of a preliminary examination of Coos Bay and Bar entrance, Oregon, "including consideration of any proposition for cooperation on the part of local interests," as provided by the river and harbor act of July 25, 1912, is submitted.

2. Coos Bay has previously been examined under provisions of the river and harbor acts of June 18, 1878; September 19, 1890; March 2, 1907; and June 25, 1910; and reports thereon will be found in Report of Chief of Engineers for 1879, page 1791; Report of Chief of Engineers for 1890, page 2936; House Document No. 958, Sixtieth Congress, first session; and House Document No. 284, Sixty-second Congress, second session.

3. Coos Bay, a tidal estuary on the Pacific coast of Oregon, about 180 miles south of the mouth of the Columbia River, is next to Humboldt Bay, Cal., the most important harbor between the mouth of the Columbia River and the Bay of San Francisco.

4. The tidal area of Coos Bay is about 15 square miles and the mean rise of the tide above the plane of reference, mean lower low water, is 5.9 feet at the bar and 5½ feet at Marshfield.

5. The ocean bar is composed of sand. Originally, before improvement, the controlling depth in the bar channel, which shifted frequently, did not exceed at times 9 feet at mean lower low tide. To effect its improvement a project was approved in 1879 to build a crib and stone jetty from a point about 250 yards below Fossil Point. About $213,750 was expended on this jetty. In 1890 a new project was approved which provided for the building of two rubble-stone jetties, at a cost of $2,466,412. (See Annual Report of Chief of Engineers, 1890, pp. 2936–2965.) The project contemplated the securing of a least depth of 20 feet at mean lower low tide in the channel across the bar.

6. The north jetty was finished in 1901, and the projected depth of 20 feet at mean lower low tide attained with the single jetty, hence it was not believed to be necessary to construct the proposed south jetty at that time, and it has not since been undertaken.

7. Immediately after the cessation of active operations on the north jetty, in 1901, the heavy seas began to beat down the enrockment, especially at its more exposed outer end, until at the present time about 900 feet of the sea end has been entirely submerged from 2 to 15 feet below low water.

8. The jetty enrockment has subsided at various places throughout its length, so that at high tide much sand is carried over it into the channel, tending to narrow and shoal it.

9. The receiving wharf and old jetty pile trestle tramway, used to place the enrockment, has been entirely destroyed by the teredo and decay. The plant used in the construction of former years has become worn out or removed to other works, so that nothing remains but a few wooden buildings in bad repair.

10. The improvement included the reclamation of the sands of the north spit above high water by planting with Holland grass (*Arundo arenaria*). About 575 acres have been set out with this grass, which continues to grow and spread and is very efficacious in holding the drifting sands in place.

11. At the present time the least depth in the bar channel is about 20 feet at mean lower low tide, but since the subsidence of the jetty there have been times when this depth has not been maintained and when the available depth across the bar for considerable periods did not exceed 17 or 18 feet at mean lower low tide. The maximum draft that can safely be carried across the bar at ordinary high water is at present 18 feet.

12. There are no bridges over the bay between the bar and the head of ocean navigation. The Willamette-Pacific Railroad Co. has made application to bridge the bay at North Bend Point with a drawbridge with two 200-foot clear openings.

13. Originally the controlling depth at low water in the bay channel between the entrance and Marshfield, 13 miles up the bay, did not exceed 8 feet.

14. Previous to June 30, 1905, the Government had expended the sum of $40,899.75 in dredging the various shoals in Coos Bay between the entrance and Marshfield to permit the vessels of increasing draft which were able to cross the bar to reach that town and had thus increased the controlling depth to 11 feet at mean lower low tide.

15. The act of March 2, 1907, appropriated $100,000 to construct a dredging plant for improving the various harbors on the coast of Oregon and Washington.

16. The 18-inch hydraulic dredge *Oregon* was completed in September, 1908, and operated at Coos Bay by funds raised by the commercial interests there. The emergency act of March 3, 1909, authorized the use of the unexpended balance of Coos Bay funds for continuing this dredging of the inner harbor.

17. A new project for the improvement of Coos Bay and Harbor was approved in 1910, and is published in House Document No. 958, Sixtieth Congress, first session. It provided for the completion of a

channel from 200 to 300 feet wide and 18 feet deep at mean low water from the deep water in the lower bay to Marshfield, the principal town on the bay, by dredging; and for the construction of a seagoing dredge to increase and maintain the depth at the bar entrance without additional jetties. Since 1905 the Government has expended the sum of about $110,000 in dredging the inner bay channels, to which sum the commercial interests of the bay have contributed at least $50,000 more.

18. This work has resulted in completing a dredged channel from the C. A. Smith Lumber Co.'s mill, just above Marshfield, to Old North Bend not less than 300 feet wide, with a least depth of 18 feet at mean lower low tide, and dredged cuts through the North Slough, Pony Slough, and Empire Shoals 200 feet wide and 18 feet deep at the same stage of the tide. This practically completes the bay dredging part of the existing project.

19. The contract for the seagoing bar dredge *Col. P. S. Michie* has been awarded, and the vessel is under construction by the Seattle Construction & Dry Dock Co., and is to be completed by July, 1913.

20. Coos Bay is one of Oregon's few important seaports, and its commerce is rapidly increasing, as is indicated by the following comparative statement of tons carried in and out over the bar from 1896 to 1912, inclusive:

Calendar year.	Carried over the bar (out and in).	Calendar year.	Carried over the bar (out and in).
	Short tons.		*Short tons.*
1896	144,934	1905	178,945
1897	115,896	1906	184,455
1898	103,039	1907	167,562
1899	116,567	1908	216,631
1900	104,294	1909	281,008
1901	97,500	1910	242,942
1902	122,232	1911	303,008
1903	135,178	1912	[1] 430,000
1904	136,958		

[1] Estimated.

21. The following is a detailed statement of the commerce carried by vessels across the Coos Bay bar during the calendar year ending December 31, 1911:

Vessel classification.

Classes.	American.	Net registered tonnage.	Passengers.
Unregistered (licensed and enrolled):			
Steamers	737	390,258	11,875
Sailing	53	25,333	
Gasoline	150	7.064	
Total	[1] 940	422,655	11,875

[1] Arrivals and clearances, irrespective of number of vessels.

Freight traffic.

Articles.	Amount in customary units.	Amount in short tons.	Value.	Rate per ton mile.
Coal	4,746 tons	4,746	$18,984	$0.0037
Dairy products	792 tons	792	316,800	.02
Fruit	178 tons	178	1,068	.01
Fish	690 tons	690	75,900	.02
Grain	669 tons	669	13,380	.0075
Hay	168 tons	168	2,520	.0075
Lumber	140,520,000 feet b. m	245,910	2,107,800	.005
Laths	17,811,000	3,345	267,615	.005
Livestock	24 head	12	1,500	.0625
Machinery	362 tons	362	36,200	.0625
Miscellaneous	41,857 tons	41,857	4,185,700	.0075
Matchwood	2,205 cords	2,205	13,230	.0299
Oil	2,244 barrels	374	1,870	.01
Shooks	218,666 pieces	1,312	39,360	.0299
Shingles	20,200 bundles	337	10,1[illegible]	.0127
Vegetables	72 tons	72	2,880	.02
Wool	9 tons	9	2,700	.0075
Total		303,008	7,097.617	

Average haul on portion of bay under improvement, 12 miles, total average haul on rivers and ocean, 400 miles, estimated.

22. The commerce of Coos Bay is rapidly increasing. It has more than doubled in the past five years. A vast region of fine standing timber, including fir, cedar, and spruce is tributary to the bay, as well as important coal fields. The C. A. Smith Lumber Co. is operating on the bay one of the finest sawmill plants on the Pacific coast, with a present monthly capacity of 15,000,000 feet b. m. This company now operates regularly to San Francisco Bay the steel steamer *Nann Smith*, carrying 1,600,000 feet b. m. of lumber on a 17-foot draft, and the steel steamer *Redondo*, carrying 700,000 feet b. m. on a 16-foot draft, and it is building a new steamer, the *Adeline Smith*, with a capacity of 1,800,000 feet b. m. on a 17-foot draft, to be ready by January 1, 1913.

23. The two larger steamers could operated much more economically on a 20-foot or more draft provided the bar and bay depths permitted. During the past two years this company shipped several cargoes of lumber to China on the steamers *Hazel Dollar*, *Bessie Dollar*, and *M. S. Dollar*, with a capacity of from 3,500,000 to 4,500,000 feet b. m. of lumber. These boats could take a load of but 2,000,000 feet b. m. on a draft of 18 feet, all the port affords at this time, and were obliged to complete their cargoes at Portland and Puget Sound points. The C. A. Smith Lumber Co. have commenced the construction of a pulp mill on the bay at an estimated cost of $500,000, which will add considerable tonnage to the port. This company is also constructing a logging railroad into its timber at an estimated cost of $600,000. Altogether, when its plans are complete in the near future, its expenditures on Coos Bay, including its steamers, will amount to nearly $3,500,000.

24. The Simpson Lumber Co.'s sawmills, and the other factories on the bay, continue to increase their outputs. The population and agricultural products of the tributary region are rapidly increasing. Marshfield, the principal town, 13 miles up the bay from the entrance, now has a population with its suburbs of 4,397, and North Bend, including Cooston, numbered 2,253 inhabitants.

25. In addition to the C. A. Smith Lumber Co.'s steamers, many other vessels crossed the bar during the year, some of them many times. The steamer *Breakwater* makes regular trips between Portland and Coos Bay points.

26. The shipyard of Kruse & Banks at North Bend built six wooden vessels last year, two of them 200 feet and over in length, and have now under construction two large wooden vessels.

27. The Willamette Pacific Railroad Co., a branch of the Southern Pacific Railroad Co., has under construction a railroad to connect the main line at Eugene with Marshfield. A contract for the whole line, about 125 miles, has been let, and a number of miles graded. This road will be completed in two years and connect at Marshfield with the Coos Bay, Roseburg & Eastern Railroad & Navigation Co. which operates a railroad to Myrtle Point on the Coquille, a distance of 30 miles. It is believed that the completion of this railroad will greatly accelerate the growth of Coos Bay commerce, and it is confidently expected that the total yearly tonnage will soon reach 1,000,000 tons.

28. The commercial interests of Coos Bay desire in addition to the proposed operations of the bar dredge to have the North Jetty restored and extended with the hope of securing from 30 to 40 feet least depth in the bar channel at mean low tide, and also that the present bay channel project be enlarged, to provide for a channel from the C. A. Smith Lumber Co.'s mill to the bar, at least 300 feet wide and 25 feet deep at low water, with turning basins in front of the towns of Marshfield and North Bend 500 feet wide.

30. The new Port of Coos Bay Commission, recently elected, proposes to raise money from the sale of bonds; and on September 9 met and passed resolutions to the effect that it would furnish $150,000 toward the restoration and extension of the north jetty and $50,000 toward the enlarged bay channel project as mentioned above, provided Congress would appropriate the balance of the funds sufficient to complete these projects.

31. A terminal railway company has been incorporated and secured a franchise from the city of Marshfield. The company is at present actively constructing its line along Front Street, Marshfield. It is bound by a common user clause to handle the freight of all railroads which may seek entrance and it is understood that its chief object is to prevent a monopoly of the water frontage in Marshfield.

32. The port of Coos Bay owns a parcel of land in Marshfield, adjoining the Standard Oil Dock, with 325 feet of deep-water front which it is expected to extend to 1,000 feet by purchase. The land extends between the harbor line and Front Street, on which is situated the tracks of the terminal company's railroad, the idea being eventually to build a wharf and transfer facilities for public use to provide against monopoly in those lines.

33.The city of Marshfield owns the foot of most of its streets that extend to the bay. At North Bend the city owns a city wharf, with about 500 feet water frontage, for public use.

34. The Coos Bay, Roseburg & Eastern Railway owns about one-half mile of water frontage at the upper end of Marshfield, on which is situated a wharf connecting with its railroad to the Coquille Valley, which extends equal terms to all. In addition, there

are many private wharves on the bay, including the mill and factory wharves at North Bend and the slip and wharves of the C. A. Smith Lumber Co. above Marshfield, where lumber is loaded on its steamers expeditiously in packages handled with electric hoists.

35. Both sides of Coos Bay for a distance of 12 miles or more, although mostly in private ownership, are available for the construction of wharves.

36. It is believed that about 1,000 feet of deep-water frontage properly located with reference to present, proposed, or probable future railroads at each of the towns of North Bend and Marshfield, and probably also at the present almost deserted town of Empire, should be owned by the public and wharves built thereon, as the needs of commerce demand, and properly arranged and equipped for the handling of traffic between water and land transportation. This to prevent monopoly of transfer and terminal facilities. The details of such reservations for public wharves as it may be desirable to require of the localities concerned, including location and extent of same, should be more fully considered in report of survey if same is ordered.

37. No valuable water power is available, as the locality under consideration is all tidal.

38. In view of the importance of the harbor of Coos Bay, the rapidity of growth of its commerce and the prospects for future growth of same, the resources of the country tributary thereto, and the expressed willingness of the port of Coos Bay to cooperate with the General Government in improving the harbor, I am of the opinion that the locality is worthy of further improvement than contemplated by existing project by the General Government in cooperation with the local interests, and I recommend that a survey and estimate be ordered as essential to the determination of the exact nature and the extent of further improvement that is desirable.

Henry H. Robert,
Captain, Corps of Engineers.

[Second indorsement.]

Board of Engineers for Rivers and Harbors,
January 14, 1913.

To the Chief of Engineers, United States Army:

1. From the facts presented by the district officer and from information furnished at a hearing before the board on January 13, 1913, which was attended by Hon. W. C. Hawley, M. C., and a delegation of citizens from the locality, the board has arrived at the conclusion that a survey and estimate should be made looking toward improvement of the bar and harbor entrance by the reconstruction and possible extension of the north jetty. It does not believe that it is necessary at this time to enlarge the channel within the bay, and therefore any survey made should be confined to the entrance. In view of the fact that the dredge is expected to begin work on the bar in the coming summer, it is deemed advisable to have the survey made as late as possible in the fall after the dredge has been given a trial, but in time to submit the results to Congress early in its next session.

It is therefore recommended that a survey be authorized as indicated above, and that the report thereon shall give, so far as practicable for comparison, the results of estimates and surveys made in connection with the regular work of improvement prior to the commencement of work by the dredge.

For the board:

Wm. T. Rossell,
Colonel, Corps of Engineers,
Senior Member of the Board.

SURVEY OF COOS BAY AND BAR ENTRANCE, OREG.

United States Engineer Office, First District,
Portland, Oreg., December 26, 1914.

From: The District Engineer Officer.
To The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Report on survey of Coos Bay and Bar, Oreg.

1. I have to submit the following report on a survey of Coos Bay and Bar, made under provisions of the river and harbor act of July 25, 1912.

2. The report on the preliminary examination was submitted under date of September 24, 1912, by Capt. Henry H. Robert, Corps of Engineers, temporarily in charge of the district. The survey was authorized under date of January 16, 1913. In recommending this survey the Board of Engineers for Rivers and Harbors recommended that the report confine itself to the bar entrance and that the survey be made as late as possible, inasmuch as the experience in operating the dredge then under construction might affect the finding. At that time it was expected to have the dredge on the bar for at least a part of the summer of 1913, but delays in its completion prevented its entrance on the work until January, 1914. Under date of April 16, 1914, the Chief of Engineers authorized delay in submission of the report until the fall of 1914, in order that this experience might be had. While the experience has not been conclusive, the report is submitted at this time as further delay will involve the postponement of final action for at least one year, if not longer.

3. A complete description of the locality, and of previous reports thereon, is given in the preliminary report. The following statement includes all material changes that are required to bring this description up to the present date.

The depths referred to in paragraph 11 have been slightly increased by the action of the dredge. The available depth over the bar is now about 20 feet at mean lower low tide. The maximum draft that can safely cross at high tide is at present about 18 feet.

The railroad referred to in paragraphs 12 and 27 is nearing completion, the bridge across the bay at North Bend Point being now under construction. Trains are now operating from Eugene to Mapleton (on the Siuslaw River) and will probably be operating to Marshfield in the fall of 1915.

There follows a detailed statement of the commerce carried by vessels across the bar during the calendar year of 1913:

COMMERCIAL STATISTICS.

Season of navigation, year 1913: Opened January 1; closed December 31.

Vessel classification.

Class.	American.	Net registered tonnage.	Passengers.
Unregistered (licensed and enrolled):			
Steamers	808	488,453	13,706
Sailing	14	3,514	
Gasoline	99	8,292	
Unrigged	8	2,886	
Total	[1] 929	503,145	13,706

[1] Arrivals and clearances irrespective of number of vessels.

Freight traffic.

Articles.	Amount in customary units.	Amount in short tons.	Value.	Rate per ton-mile.
Box shooks	108,280 bundles	2,707	$81,210	$0.013
Broom handles	1,000,000 pieces	300	18,000	.02
Chittim bark	219 tons	219	21,900	.02
Coal	2,825 tons	2,825	11,300	.0075
Cordwood	436 cords	654	1,744	.01
Dairy produce	219 tons	219	87,600	.02
Doors	33,600 pieces	672	50,400	.02
Fish	12,320 cases	462	73,920	.027
Fruit	71 tons	71	4,260	.027
Grain	676 tons	676	13,520	.013
Hay	426 tons	426	6,390	.01
Lath	179,325 bundles	7,173	71,730	.005
Logs	17,211,000 feet b. m	34,422	120,477	.005
Lumber	178,608,000 feet b. m	357,216	2,232,600	.005
Machinery	793 tons	793	158,600	.027
Matchwood	40 cords	40	400	.013
Miscellaneous	51,937 tons	51,937	5,193,700	.027
Moldings	39,000 pieces	39	3,510	.02
Oil	14,648 barrels	2,458	16,112	.01
Poles	68,550 linear feet	1,200	7,200	.01
Railroad iron	1,710 tons	1,710	68,400	.02
Railroad ties	6,928 ties	582	3,492	.005
Shingles	212,000 bundles	4,240	106,000	.013
Spars	87 pieces	29	2,610	.01
Vegetables	9 tons	9	360	.02
Veneer logs	896,000 feet b. m	1,792	10,752	.01
Veneer panels	54,660 pieces	492	91,840	.02
Wool	13 tons	13	4,550	.027
Total		473,376	8,462,577	

Average haul of freight, 400 miles; average haul on portion under improvement, 14 miles.

To the tabulation in paragraph 20 there should be added the following for the years 1912, 1913, and 1914:

Calendar year.	Carried over bar, out and in.
	Short tons.
1912	406,727
1913	475,376
1914	[1] 530,000

[1] Estimated.

These statistics show a steady increase in the water-borne commerce.

4. The port of Coos Bay two years ago offered to contribute $150,000 toward a restoration and extension of the north jetty and $50,000 toward the deepening and widening of the inner channels, provided the Federal Government would assume the balance of the cost of the combined project. This offer to contribute to the cost of the jetty is now withdrawn, but the port has raised $600,000 by the sale of bonds and is engaged in widening and deepening the inner channels by contract with the Puget Sound Bridge & Dredging Co. The present status of the work is as follows:

Their project provides for excavating the ship channel from Bay City mill, on Isthmus Slough, to a depth of 25 feet at mean lower low tide, between the harbor lines to Marshfield, where a turning basin of the same depth 500 feet wide in front of the town is to be provided. From Marshfield to deep water opposite Fossil Point, in the lower bay, the channel is to be 25 feet deep at mean lower low tide and 300 feet wide, with a turning basin 500 feet wide opposite the town of North Bend. All of this work has been accomplished except the widening of the channel for about one-fourth of a mile just above North Bend and through a part of the Pony Slough Shoal and at the lower end for about one-half mile above Fossil Point. In addition, the port has deepened the channels of several of the tributary inlets of the bay. Incidental to this work the port has filled the depression formerly known as Mill Slough and effected a considerable improvement to low-lying real estate in that vicinity, which has contributed to the cost of the work.

5. The U. S. dredge *Col. P. S. Michie*, designed and constructed for work on the Coos Bay Bar under the project adopted in 1910, was completed about a year ago and commenced work on the bar January 24, 1914. The vessel is 242 feet long over all, has 42 feet beam, draws 9 feet forward and 11 feet aft when light and 17 feet when loaded. She is equipped with a 25-inch pump, carries about 1,200 cubic yards when loaded, and can pump her bins full in about one hour. Dredging commenced on January 24, 1914, and continued on the few occasions when work was possible during January, February, and March. Really effective work was not possible, however, until April. During April and May she removed about 106,000 cubic yards. On May 29 she was rammed by the steamer *A. M. Simpson* and lost 38 days of good working weather, resuming operations on July 6. During the remainder of this month and the first half of August she removed 82,000 cubic yards. She grounded once on the south spit, but released herself without serious damage. It became necessary to suspend operations for lack of funds August 15. She resumed work October 7, but was withdrawn because of unfavorable bar conditions October 23. Altogether she was available for work on the Coos Bay Bar 183 days between January 24 and October 23, inclusive, during which time she was able to work on the bar parts of 72 days, in all 404 hours, of which 247½ hours were employed in actual pumping. During this time she removed from the bar and dumped at points about 1 mile to seaward 224,394 cubic yards of sand. She was out of commission twice for a total of 90 days during the most favorable working season. It is believed that had she been in commission during these two periods she would have

removed an additional quantity of about 225,000 cubic yards. Depths on the bar were increased from 17 to 22 feet until suspension of operations on August 15, but shoaled during the subsequent idleness about 18 inches. Until May 29 she worked eight hours each day, but since that time as many daylight hours as the condition of the bar permitted. The maximum amount dredged in any one day was 7,426 cubic yards, on August 14. She has filled the bins with about 1,250 cubic yards in about one hour.

6. The dredge is believed to be slightly deficient in boiler capacity and, when operating with the original drag head, in power. These defects were enforced on her by lack of funds, the alternative being at least a year's delay in construction. Arrangements have been made to increase her boiler power during the coming winter season. With this increased power and with a smaller drag head (which has been experimented with) and a few minor modifications, it is believed that she will be able to remove 400,000 cubic yards of sand from the Coos Bay bar in a season. It is expected to return the dredge to the bar about May 1, 1915.

7. Surveys were made of the bar in June, 1914, and in October, 1914, by Mr. C. R. Wright, under the general direction of Mr. J. S. Polhemus, assistant engineer. Owing to the lateness of the season this last survey was less complete than could have been desired, but was sufficient to show the changes of the few months that had elapsed. Tracings of these surveys are forwarded herewith.

8. The present condition of the jetty is as follows: The outer end, for about 1,100 feet, is from 1 to 15 feet below the plane of mean lower low tide; the next 225 feet is about extreme high-water mark; and the remainder of the jetty, shorewards to high-water mark (about 4,000 feet), is from 3 to 4 feet above mean low tide, with some short stretches somewhat lower. The channel lies close to the jetty and is comparatively narrow, there being only about 700 feet from the axis of the jetty to the 18-foot contour on the south shoal. On the bar beyond the end of the jetty the south shoal impinges slightly more than formerly, due to the lowering of the outer end of the jetty. The jetty is marked by a buoy off its end and by the short stretch remaining above high water. The entrance is dangerous, especially during foggy weather, which is of common occurrence. The channel, to be satisfactory, needs width as well as depth, and will be much more dangerous when the short remaining stretch of jetty, which now, as a landmark, offers great assistance to vessels entering, shall have been beaten down to the condition of the balance of the jetty, in probably two or three seasons more. Masters of vessels making trips over the bar at weekly intervals or less have stated that unless the entrance has a much greater width than at present when this short stretch of jetty subsides, the entrance to the bay will be exceedingly hazardous.

9. With reference to the work done on the inner channels by the port of Coos Bay, it may be stated that the local interests have provided wider channels throughout than were called for by the Government project and have almost completed the first dredging to a depth of 7 feet in excess of the depth provided by the Government project. This depth is considerably in excess of that required by vessels that can now cross the bar, but is not excessive for the most economical lumber carriers. The port entertains the hope that its assumption of the first work on the inner channels may have the effect

of securing a deeper and wider channel across the bar by the influence it may have on securing an early decision to rebuild the jetty. The work has had the effect of relieving the Federal Government of the annual maintenance charge on the inner channels for some years to come, but will be largely a wasted endeavor unless some substantial improvement of the entrance is effected.

10. The old jetty is still doing good work in maintenance of the channel across the bar. There is no doubt that its effect on ebb flow keeps the present channel well in place and would maintain channel depths of 16 to 18 feet without the assistance of the dredge so long as the jetty retains its present effectiveness. It is also certain that a restored jetty would to some extent increase depths without a dredge. The concentration of ebb currents is slightly reduced by the submergence of the outer end of the jetty. Probably of more importance, however, as regards the channel the volumes of sand that now come in over the jetty with flood tides, especially in stormy weather, would be almost entirely cut off by a jetty restoration. It is believed that even with a restored north jetty dredging will be required annually. The entrance channel will always hug the jetty near the outer end, and some dredging will be required at the cross over in the channel inside the end of the jetty, as well as on the bar, but most of the dredging effort could be applied to increasing the usable width rather than for depths.

11. Experience with the dredge has not been as complete as was hoped. As stated before, fully half the best season for work was lost. It was, however, demonstrated that for at least four months of every year her opportunities for work outside will be so rare that it will be inadvisable to keep her in commission in Coos Bay, where she can not be employed inside, principally because there is lack of suitable dumping space for a dredge of this type. Experience has also shown that work on the bar is not easy. The ebb currents on the big tides were too strong to permit efficient work when at their maximum. This, however, it is expected to remedy this winter. The space, too, is so restricted as to often threaten the loss of the dredge either by her grounding on the south spit or by striking the submerged jetty. With the constant northwest swell during the working season, the prevalence of fogs during the same time, the necessity for passing vessels occasionally while at work, all in a narrow channel closely flanked on one side by a shoal and on the other by a jetty entirely submerged for over 1,000 feet, and with only one short section clearly visible, conditions for dredging during the favorable season are about as bad as any conditions under which dredging is possible. Aside from its effect on the bar channel, a restored jetty would largely reduce these dangers and considerably increase the working hours of the dredge on the bar, not only by enabling work to be done occasionally in lighter fogs and mists, in which the vessel now has to be withdrawn, but by the protection offered by a restored jetty against northwest swells which would permit the dredge to operate on the shoal inside the entrance when the swell is too heavy to permit work on the bar.

12. This office anticipates that with the changes proposed in the power and auxiliary machinery of the dredge not less than 400,000 cubic yards of material, and possibly considerably more, can be removed next summer, unless some accident is met with or funds fail

(both of which contingencies occurred last season). What effect this will have it is impossible to predict, as the heavy storms of the coming winter may cause considerable deposits. It is believed that a considerable deepening (over depths that will be found at the conclusion of the winter season) and some widening can be effected. This office, however, does not entertain the hope that a suitable channel can be created or maintained by the dredge without more assistance from the jetty, which will, of course, give somewhat less assistance each year until restored. It is not believed that any extension is necessary beyond the length of the former jetty, nor is it believed that a south jetty will be necessary, now or in the future. It is believed that when restored the jetty should follow approximately the old line to take advantage of the foundation which is still there, and that the outer end should be considerably widened and should be constructed mainly of heavier rock than formerly. Beyond this no extraordinary construction is believed advisable. The usual methods of construction on this coast (a double-track pile trestle from which rock is dumped) should be followed. Estimate follows:

Restoration of wharf and purchase of plant	$130,000
10,400 feet of double track tramway, at $10 per linear foot	104,000
320,000 tons of rock, at $1.25	400,000
120,000 tons of rock, at $1.75	210,000
Engineering, contingencies, etc., about 20 per cent	156,000
Total for restoration of north jetty	1,000,000

In this estimate the possibility of having to secure heavier rock for the outer end is contemplated, as it is possible that a heavier rock than can be supplied locally may be required on this exposed part of the construction. A quarry of basaltic rock has been prospected for this purpose. It is located on Daniels Creek, on the property of the Simpson Lumber Co., about 7 miles from tidewater, to which it may be hauled over a logging railroad owned by that company. Should this develop into a good quarry of suitable rock a considerable saving is possible. There are good outcrops in the Siuslaw Valley which can be brought in by rail after about one year should it be impossible to find a suitable rock nearer at hand.

13. It is believed that by thus building on the site of the old jetty a much longer life will be assured. It is believed that this construction, with the assistance of the dredge, will give a channel of at least 24 feet depth at low water and allow for the width to be increased so that that depth may be carried at least 800 feet from the axis of the jetty. This width and depth would accommodate vessels of 20 and 21 feet draft in the regular service and would allow for the use of the most economical lumber carriers (24 feet), except during the heaviest swells.

14. The port of Coos Bay has given evidence of its own confidence in the future of the locality. Besides bonding itself to the extent of $600,000 to widen and deepen the inner channels, it furnished funds for part of the dredging of the inner channels in 1909 prior to the adoption of the 1910 project for that work, it kept the dredge *Oregon* in commision on its inner channel work last summer until funds were provided by Congress requiring her withdrawal for work at Grays Harbor, and it furnished the funds for two weeks of operation of the dredge *Michie* on the bar. It is believed that this actual per-

formance should not be without its influence in determining the department to furnish an entrance suitable to handle the existing and prospective commerce, especially as it can still be done well within the limit of cost fixed in the project of 1890.

15. With respect to cooperation by local interests it may be stated that the port has already assumed the task of providing for channels within the bay of considerably greater magnitude, both as to width and depth, than are fixed in the Government project, and of dimensions greater than the Government would be likely to have adopted until the commerce of the locality had considerably increased over its present volume or any volume that the immediate future promises. Their resources seem sufficient to warrant the belief that they can take care of all this work, leaving the work on the entrance to the General Government. Attention is invited to a letter from the port dated December 22, 1914, in which they offer to assume inner-channel work, and it is suggested that it would not be unreasonable to require, prior to entering on the work at the entrance, that the port assume the maintenance of inner channels of the same capacity as those now in the approved Government project.

16. I am of opinion that the reconstruction of the jetty at an estimated cost of $1,000,000 is a project worthy to be at once undertaken by the United States, without cooperation on the part of the locality, except the assumption of work on the inner harbor required to maintain the widths and depths created by the Government three years ago.

17. It is estimated that the construction will consume three years. The first appropriation should be about $250,000, with authority to enter into a continuing contract for the entire work, or for rock for the entire work, if the construction be undertaken by hired labor. The estimate provides for maintenance during construction, but an annual maintenance charge of $60,000 will be required for operation of the dredge, as it is believed the estimate of $50,000 in the project of 1910 is not sufficient to provide for depreciation and repairs as well as operation.

18. There are no questions on collateral related subjects that have not been covered in the preliminary report. With reference to public terminals, however, it may be stated that both Marshfield and North Bend have taken up the treatment of this important question, and it is believed that public wharves providing for transfer from ship to rail will be provided at both places sufficient to protect the public interest.

JAY J. MORROW,
Major, Corps of Engineers.

[First indorsement.]

UNITED STATES ENGINEER OFFICE,
NORTHERN PACIFIC DIVISION,
Portland, Oreg., December 30, 1914.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded.

2. The history of this work indicates that the outer end of the jetty is exposed to particularly heavy wave action. The construc-

tion proposed by the district officer will not be permanent and future rebuilding will be expensive. In 1908 the then district officer proposed to protect his suggested 1,000-foot extension and the outer 500 feet of the present jetty by a covering of 40-ton concrete blocks. An assistant engineer long connected with the work has suggested this plan: To use steel piles instead of timber ones in the outer end of the jetty, with the idea that the piles and the bracing between them will hold the stone mass together. Either plan would be more expensive than that of the present district officer.

3. A satisfactory test of dredging at this place would involve the use of an efficient dredge working the maximum practicable part of the working season. The test of 1914 was unsatisfactory in both particulars. The changes and additions recommended for the *Michie* will greatly increase her suitability for work at this place. In order to take advantage of all favorable weather during the working season it would be advisable, in my opinion, to put three crews on the vessel, and, even at considerable expense, to mark the bar channel and the "crossover" so that work may go on at night. Under these conditions the output of the dredge for a season would probably be much in excess of the 400,000 cubic yards estimated by the district officer.

4. Until we know the quantity of material which the dredge can remove from the channel in a working season and the quantity which nature will deposit in the channel in the working season and in the winter season, there is no way that I can see to judge whether the district officers plan for obtaining a 24-foot channel will certainly accomplish that object. In 1898 the then district officer, in order to obtain "the greatest improvement in the bar channel that can be accomplished by jetty work and dredging combined" thought that in addition to dredging it would be necessary to restore the north jetty and to extend it 1,000 feet and to build a south jetty. (H. Doc. 958, 60th Cong., 1st sess.) There is no way to compare that project with the one suggested by the present district officer, since the depth expected under that project was not definitely stated; the belief in the district office is that 25 feet was thought obtainable. But in the absence of knowledge of what dredging will accomplish, there is the same difficulty in estimating what results that may be expected from the 1908 project as in the case of the plan now submitted by the district officer. The project of 1908 is a much more expensive one than that recom mended by the present district officer. In other words, the expense to which the United States may be committing itself in embarking upon a 24-foot project can not be closely estimated.

5. The present commerce of this port is amply sufficient to justify the maintenance of the channel depth called for by the project of 1890, namely, 20 feet. It appears likely that the *Michie* will be equal to this task, even if the north jetty should suffer a slight further reduction in height.

6. The commercial advantages that would result from an increase of depth in this entrance are considerable. The cost of marketing lumber in domestic ports would be reduced, and if a sufficient depth were obtained (say, 26 feet) shipment of lumber direct to Asia and Australia would be possible. It seems advisable, however, to carry the present project to completion; that is, to make a thorough and exacting test of dredging before submitting a project more extensive and costly than the present one. Delay need not necessarily result. It

is probably too late, and probably impossible for other reasons, to get an appropriation for the district officer's plan in the pending river and harbor bill. The result of the dredging test will be known from a survey made in the early spring (say, March) of 1916. I recommend that final report on this survey be not submitted to Congress until after that survey.

C. H. McKinstry,
Lieutenant Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbor on survey, see p. 3.]

LETTER OF THE PRESIDENT OF THE PORT OF COOS BAY.

Portland, Oreg., *December 22, 1914.*

Dear Sir: Representing the port of Coos Bay, I desire to call to your attention a few facts in connection with the harbor of Coos Bay.

In the year 1890 Congress adopted a project for the improvement of the entrance to Coos Bay, which involved, according to the engineers' estimate, an expenditure of $2,466,412. Since the adoption of that project by Congress there has been expended in the improvement of the harbor of Coos Bay up to the 1st of July of the present year the sum of $1,478,893.49, of which $213,750 was expended in the construction of the submerged jetty, referred to in the report of the district engineer as the Fossil Point Jetty; the sum of $90,000 for dredging the inner harbor, and $378,198.63 for the construction of the bar dredge *P. S. Michie*, and $24,567.17 for the operation of this dredge.

The amount expended on the submerged jetty, known as the Fossil Point Jetty, in addition to the $90,000 expended for dredging the inside harbor and the cost of construction and operation of the bar dredge *Michie*, shows that there was actually expended in the construction of the north jetty and its maintenance the sum of $772,378. There is left the sum of $1,291,000 of the engineers' estimate of 1890, which has not been expended in the improvement of this harbor. In other words, it was necessary to expend $1,291,000 less than the engineers estimated would be necessary to give the project of 1890, which contemplated a channel 18 feet deep at mean lower low water.

The port of Coos Bay commissioners believe that it would not be necessary to expend even this balance to restore the jetty to its original length. Conditions have changed considerably since the original work was done on the jetty. The larger interests, particularly the shipping interests, believe that it is necessary to have the jetty restored and rebuilt in order to make it safe for vessels to enter and depart from the harbor of Coos Bay. The jetty at the present time, through the action of the winter storms and the heavy seas prevailing, has been almost entirely destroyed, and the remaining portion, which is the only really safe landmark that vessels have in entering and departing from the harbor, is liable to disappear at any time. When this remaining portion of the jetty disappears, it will make it a very hazardous proposition for vessels either to enter or depart from Coos Bay.

The people of Coos Bay, believing and replying in the opportunity to create one of the great seaports on the Pacific Coast at Coos Bay, have shown their faith by bonding themselves for $600,000 for the improvement of the inner harbor. No other community on either the Atlantic or Pacific coast has bonded itself for such an amount of money when compared to the population of the district issuing the bonds. The money raised by this bond issue has been expended in the improvement of the inner harbor under a project adopted by the port of Coos Bay, which contemplates a channel 300 feet wide and 25 feet deep at mean lower low water from the bar to the Smith Mills above Marshfield. A contract has been entered into between the port of Coos Bay and the Puget Sound Bridge & Dredging Co. for the completion of the port's project, and by July 1, of the year 1915 this project will be completed. The port of Coos Bay at a recent session agreed, and is in a position to guarantee to the United States Government, that it will forever maintain a channel as deep and as wide as the Government's project of 18 feet at mean lower low water, or deeper if necessary, provided the Government will improve the entrance to the harbor.

The present issue of bonds of the port of Coos Bay is sufficient to complete the port's project, which will give a channel 25 feet deep at mean lower low water, and 300 feet wide from the Smith Mills to the bar, and it is the opinion of the commissioners of the port of Coos Bay that with the expenditure of the balance of the original amount of the estimate of 1890, that the harbor of Coos Bay will have the necessary depth at its entrance.

When the first work of improving the harbor by the construction of the north jetty was undertaken, it was not possible to secure suitable rock for its construction. Since that time the development of the logging industry a railroad has been constructed which reaches a large deposit of basaltic rock, and experiments made by the owners of this railroad by blasting have demonstrated that this rock can be secured in very large integrals. The company owning and operating this railroad are so largely interested in the shipping industry that they can safely be counted upon as supplying this rock from quarries which they will open at practically cost. There are a large number of barges or scows on the bay that can be secured by the Government for a nominal sum, thus saving an additional expense in equipment.

A landing could undoubtedly be made at a much more convenient point than the location of the original Government works, which would save the expense of reconstructing at least one-half mile of the old original tramway. Private interests on Coos Bay would undoubtedly cooperate with the Government, believing that the development of the harbor would be more to them than any financial gain that they might have through profits in supplying material; and the port of Coos Bay, believing that it has done its share in the development of its harbor, stands ready to aid and assist the Government in any contemplated improvements.

Yours, very truly,

L. J. SIMPSON,
President of the Port of Coos Bay.

Maj. J. J. MORROW,
Corps of Engineers.

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64th Congress, 2d Session. } HOUSE OF REPRESENTATIVES. { Document No. 1723.

LEAF RIVER, MISS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON REEXAMINATION OF LEAF RIVER, MISS.

December 11, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

War Department,
Washington, *December 9, 1916.*

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 7th instant, together with copy of a report from Lieut. Col. C. Keller, Corps of Engineers, dated January 27, 1916, with map, relative to the project for improvement of Leaf River, Miss., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, December 7, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of Leaf River, Miss.

1. Under authority contained in section 14 of the river and harbor act approved March 4, 1915, there is submitted herewith for transmission to Congress report dated January 27, 1916, with map, by Lieut. Col. C. Keller, Corps of Engineers, relative to the project for improvement of Leaf River, Miss.

2. The Leaf River has a length of about 135 miles, and unites with the Chickasahay at Merrill to form the Pascagoula River. The original and existing project was adopted by the river and harbor act of September 19, 1890, and provides for making a channel for high-water navigation by the removal of obstructions and overhanging trees from Bowie Creek to the mouth of the river, a distance of 78.8 miles. The amount expended on the project to June 30, 1915, was $40,516.20. The commerce consists entirely of timber and its products carried on rafts, which can be floated at mean and high stages without improvement. Excepting an occasional launch, there are no boats on the river. The district officer is of opinion that the river is not worthy of further improvement and that the project should be abandoned. The division engineer and the Board of Engineers for Rivers and Harbors concur in this opinion.

3. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the abandonment of the project for improvement of Leaf River, Miss.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
June 20, 1916.

To the Chief of Engineers, United States Army:

1. The following report on the Leaf River, Miss., is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads, "and the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. The Leaf River is about 135 miles in length. It unites with the Chickasahay at Merrill to form the Pascagoula River. The reach under consideration is from Bowie Creek, near the town of Hattiesburg, to the mouth, a distance of 78.8 miles. The river is generally tortuous and filled with snags, logs, shoals, and stumps. The controlling depth at mean low water is about 1.1 feet. The discharge at Hattiesburg at mean low water is 840 second-feet and at extreme low water 650 second-feet. The fall from Hattiesburg to the mouth is 93.96 feet. A railroad parallels the river throughout this reach and is from one-fourth mile to 2½ miles distant. The banks are almost continuously wooded, with less than 10 per cent under cultivation, and there is very little evidence of human habitation near the river.

3. The commerce for 1914 is reported as amounting to 179,061 tons. It consists entirely of timber and its products floated in rafts. Excepting an occasional launch, there are no boats on the river. At mean and high stages timber can be floated without improvement.

4. The existing project, adopted by the river and harbor act of September 19, 1890, provides for making a channel for high-water navigation by the removal of obstructions and overhanging trees at an estimated cost of $25,000. There had been expended to June 30, 1915, $40,516.20, of which $29,497.16 was for maintenance. The district officer is of opinion that the river is not worthy of further improvement and that the project should be abandoned. The division engineer is in general accord with the views of the district officer.

5. Interested parties were informed of the present investigation and given an opportunity of submitting their views. Two communications have been received and given consideration.

6. It will be seen from a study of the reports bearing upon this stream that it is practically unnavigable at low stages; that the only commerce is logs, timber, etc., which are floated at medium and high stages, and for which improvement is not essential; that the physical conditions of slope and discharge are such as to preclude any useful improvement at reasonable cost; and that expenditures under the existing project are not giving adequate returns. In view of these conditions, the board concurs with the district officer and the division engineer and recommends legislation authorizing the abandonment of the project for the improvement of the Leaf River, Miss.

For the board.

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF LEAF RIVER, MISS.

United States Engineer Office,
Mobile, Ala., January 27, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Report on reexamination of Pascagoula, Leaf, and Chickasahay Rivers, Miss.

1. In compliance with department indorsement, dated May 3, 1915, reexamination of the Pascagoula, Leaf, and Chickasahay Rivers, Miss., has been made, the general purpose of which is set forth in the concluding sentence of section 14 of the river and harbor act approved March 4, 1915, as follows:

> * * * And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made.

The report of this reexamination is contained in the succeeding paragraphs, being subdivided into three portions, each one of which relates to the corresponding one of the three streams under consideration.

PASCAGOULA RIVER (ABOVE THE MOUTH OF DOG RIVER).

* * * * * * *

LEAF RIVER (FROM BOWIE CREEK TO THE MOUTH).

34. *Geographical features.*—The source of this river is in southeastern Mississippi. The stream is about 135 miles long, having a drainage area of 3,369 square miles, of which about 2,772 square miles is above Hattiesburg. The head of the section under consideration is at the mouth of Bowie Creek, near Hattiesburg, Miss. The river flows in a southeasterly direction through Covington, Jones, Forrest, Ferry, and Greene Counties, and joins the Chickasahay River at Merrill, Miss., forming the Pascagoula River. The distance from the mouth of Bowie Creek to Merrill is 78.8 miles. The uplands are for the most part cut-over pine lands. In their original condition the uplands were heavily covered with long-leaf yellow pine and the stream valleys or bottoms with a mixed growth of oak, gum, and cypress.

35. The principal tributaries of the Leaf are Oakahay and West Tallahala Creeks, the junction of which form the Leaf River near Oakahay, Miss.; Bowie Creek, at Hattiesburg; Tallahala Creek, at Mahned; Thompson Creek, at Beaumont; Gaines Creek, above McLain; Rogers Creek, below McLain; and Oaktibee Creek, near Leaf.

36. *Previous examinations.*—The report of an examination of the Leaf River from its mouth to the mouth of Bowie Creek is printed in annual report for 1889, page 1462. This is the basis of the original, which is the existing, project adopted in 1890. The stream was considered worthy of improvement for high-water navigation during about five months of the year by the removal of snags, logs, and overhanging trees, at a cost not to exceed $25,000.

37. A survey of the Leaf, authorized by the river and harbor act approved March 3, 1909, was made during 1910, as a result of which the district officer reported that this stream with the Pascagoula were worthy of improvement to the extent of his 4-foot project, estimate No. 2, at a cost of $110,500, with annual maintenance at $15,000. The division engineer was unable to agree with the views of the district officer as to the practicability of accomplishing the desired results at the estimated cost, and stated that the commerce involved would not justify the large expense necessary. In its review the Board of Engineers for Rivers and Harbors reported that the cost of providing effective water transportation would be far greater than the figures given above; that the expense involved would be out of reasonable relation to the resulting benefits; and that it was not desirable to undertake any additional improvement of the Leaf and Pascagoula Rivers at this time. (See report of district engineer officer dated Sept. 30, 1911, and report of board dated Nov. 4, 1912, not yet published.)

38. *Previous improvements.*—Under the existing and original project $11,019.04 was expended for improvement by the removal of snags and overhanging trees. The project was completed in 1897 so as to allow light boats and large rafts of logs and timber to navigate the river at high water for a distance of 60 miles above Merrill. From 1897 to June 30, 1914, $28,319.80 was expended on maintenance. No actual channel work was done during fiscal year 1915, the expenditure of $1,177.36 for the year being for care of plant only.

39. *Present examination.*—The present examination was made in a skiff, and was commenced August 4, 1915, at the River Avenue

Bridge at Hattiesburg, and completed at the mouth of river on August 7, 1915. On leaving Hattiesburg the river was 0.5 feet below mean low water, remaining at a stand until August 6, 1915, when a local rise of 0.4 feet over night occurred, due to a heavy rain. On August 7, 1915, at Merrill the river was 0.3 feet below mean low water. All depths herein given are referred to mean low water.

40. With the exception of a few straight and clear sections, the river is tortuous, and is filled with snags, logs, shoals, and stumps. The current is fairly uniform for the entire section.

41. Soundings were taken as often as practicable, especially on shoals that had a depth of 3 feet or less. Of the 70 shoals found above Merrill, 41 are composed of gravel and 29 of sand. These shoals are formed primarily by deposits at accumulations of snags, stumps, and logs. The river bed is sand and gravel which shifts easily and quickly when not reinforced by snags. Photographs[1] of the bridges and the river are attached to this report.

42. The river banks are almost continuously wooded, clearings appearing only at old log landings and bridge sites. Few fields bordering the river are under cultivation, but in most cases where the banks are of a sufficient height to permit the cultivation of the soil the cultivated lands are at least a mile distant from the river, less than 10 per cent of the area of drainage basin contiguous to the section of river being under cultivation. The banks are subject to erosion, particularly in the lower 10 miles, where the loamy banks show considerable caving. From Mahned to Oaktibee Creek, a distance of about 52 miles, soft limestone bluffs and ledges which meander from side to side form the river banks.

43. The New Orleans, Mobile & Chicago Railroad parallels the river and is from one-fourth mile to 2.5 miles from it all the way from Hattiesburg to Merrill. This road also crosses the river at Beaumont. Besides the above, the New Orleans & Northeastern, Gulf & Ship Island, and Mississippi Central Railroads enter Hattiesburg.

44. On account of snags, logs, and overhanging trees it was originally impracticable to navigate this river. The minimum width was 100 feet and the minimum depth at mean low water was perhaps 1 foot.

45. Even now there are no boats on the Leaf River at any season other than a few light-draft launches. A small boat has in the past been as far as Hattiesburg, but this was before the present bridges were built and only one trip was undertaken.

46. At the time of the present examination there was a controlling depth of 3.3 feet at mean low water between the mouth of the Leaf and the Gulf of Mexico, but the channels were obstructed in many places by logs and snags.

47. The controlling depths at mean low, mean, and high stages of the Leaf River are 1.1, 4, and 19.1 feet, respectively.

48. The maximum fluctuations at Hattiesburg and Merrill are 18 and 24.1 feet, respectively.

49. The discharge at Hattiesburg during mean low water is 840 and during extreme low water 650 cubic feet per second. The corresponding discharges at its mouth are 1,170 and 700 cubic feet per second, respectively.

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[1] Not printed.

50. The fall in between Hattiesburg and Merrill is 93.96 feet, a comparatively regular slope being found to exist. No tide is observed above Merrill.

51. Periods of low water usually occur during the months of June, July, August, September, October, and November, during which navigation of any sort other than by a small skiff or raft is impossible, due to the many snags, logs, and stumps. During mean and high stages, which occur in December, January, February, March, April, and May, there is ample depth and width of channel for the navigation of steamboats up to the fixed bridge at McLain, 18.5 miles above the mouth, where this bridge renders further progress impossible. Many other fixed bridges occur above this point, these being listed in the table appended hereto. However, rafting can be carried on through the six high-water months for the entire distance, as the high-water bridge clearances range from 9 to 15.4 feet for the 10 bridges below Hattiesburg.

52. Lumber and timber are rafted during the winter and spring months. The crops, consisting mostly of cotton and its products, are moved September 1 to January 1, but are not shipped by river.

53. *Terminal facilities.*—There are no wharves or terminal facilities on this stream at present, as no occasion has arisen for their use, nor are there any mechanical appliances for handling freight.

54. *Water power.*—No question of water-power development is involved.

55. *Local cooperation.*—There has been no local cooperation.

56. *Land reclamation.*—No question of land reclamation arises for consideration.

57. The character of the river from Hattiesburg to its mouth is shown in the following table:

Section.	Length of section.	Shoals.			Width of river.		Height of bank.	Character of obstructions.
		No.	Least depth (mean low water).	Character.	Minimum.	Maximum.		
	Miles.		*Feet.*		*Feet.*	*Feet.*	*Feet.*	
River Avenue Bridge at Hattiesburg to Mahned Bridge.[1] [2]	26.6	32	1.1	25 gravel, 7 sand.	90	265	6 to 25	Logs and snags.
Mahned Bridge to Beaumont railroad bridge.[1] [3]	19.8	15	1.7	9 gravel, 6 sand.	100	400	6 to 30	Do.
Beaumont railroad bridge to McLain Bridge.[1] [4]	12.3	10	1.5	3 gravel, 7 sand.	100	450	8 to 25	Do.
McLain Bridge to mouth of river.[1] [5]	18.5	13	0.9	3 gravel, 10 sand.	150	450	6 to 15	Slides, logs, and snags.

[1] The banks are of sand, gravel, and soft rock.

[2] Below River Avenue Bridge width of river on either side of a flat bar is about 50 feet.

[3] Wreck of old steel bridge in river on left at Wingate below present bridge.

[4] Shoals out of water throughout this section.

[5] Bluff 80 feet high just below Rogers Creek.

For the section from McLain Bridge to the mouth it was impossible to navigate skiff through the deep water owing to the heavy accumulation of drift and snags on the channel side.

58. *Resources and commerce.*—Between Hattiesburg and the mouth there is very little evidence of human habitation on the banks of the river. At two of the four localities where houses were to be seen from the river, one is the veneering plant owned by Hammitt and

F. G. Carley, about 56 miles above the mouth and 0.5 mile from Belleville on the New Orleans, Mobile & Chicago Railroad. The other is the 100,000 capacity shingle mill owned by J. E. Justice about 23 miles above mouth and about 1 mile from Little Creek on the New Orleans, Mobile & Chicago Railroad. Both of these plants are in full operation.

Only the latter firm uses the river as a means of rafting logs to the sawmill from points farther upstream. The manufactured material is then hauled by wagon to the railroad.

59. Of the towns mentioned in the accompanying statement of population, McCallum, Mahned, New Augusta, Wingate, Beaumont, McLain, and Leaf are located along the railroad with highways leading to corresponding bridges that span the river. Sawmills exist at practically all of these towns. Those that have none serve as log-shipping points.

60. During the present examination rafting operations were noticed at only one place, where supplies were being rafted to the J. E. Justice shingle mill before mentioned. However, evidence of recent logging is plentiful.

61. Hattiesburg, at the head of the section under consideration, is the only locality of any size that might benefit were the river made navigable. This city is very enterprising and progressive. Of the four railroads which enter the city, three are direct lines to ports on the Gulf coast. Attention is invited to a pamphlet[1] on the agricultural and industrial progress of Hattiesburg, accompanying second indorsement,[1] dated February 1, 1915, this being a supplemental report in connection with report dated September 30, 1911, of the survey of the Leaf and Pascagoula Rivers, Miss., from the mouth of Bowie Creek to the mouth of Dog River. The water-borne commerce shown for calendar year 1914 is that given by the Chamber of Commerce of Hattiesburg, which is evidently a carbon copy[1] of the statistics furnished by Mr. F. H. Lewis, of Pascagoula, Miss. No other information as to water-borne commerce was obtainable.

62. The towns adjacent to the river, with their population as shown by the census of 1910, and their approximate distances from the river, are as follows:

Towns.	Population.	Distance from river.
		Miles.
Hattiesburg, Miss	17,733	1.0
Petal, Miss	225	0.5
McCallum, Miss	25	1.5
Mahned, Miss	125	1.5
New Augusta, Miss	225	2.0
Wingate, Miss	50	3.0
Beaumont, Miss.[2]	200	1.0
Glazier, Miss	25	8.5
Hintonville, Miss	25	6.0
Kittrell, Miss	25	2.0
McLain, Miss	275	1.5
Neely, Miss	25	5.0
Leaf, Miss	175	1.0
Total	19,133	....

[1] Not printed.

[2] New Orleans, Mobile & Chicago R. R. crosses river at this locality.

63. The counties bordering on the river, their population, as shown by the census of 1910, together with their areas, are as follows:

Counties.	Population.	Approximate area.
		Sq. miles.
Forrest	20,722	436
Perry	7,685	1,091
Greene	6,050	819
Total	34,457	2,346

64. Commerce for the calendar years 1910, 1911, 1912, 1913, and 1914 is as follows:

Articles.	1910		1911	
	Tons.	Valuation.	Tons.	Valuation.
Round logs	210,000	$1,050,000	163,500	$654,000
Hewn and sawn timber	8,000	76,000	3,600	36,000
General merchandise	50	2,250	20	1,000
Crossties	....	....	....	....
Total	218,050	1,128,250	167,120	691,000

Articles.	1912		1913		1914	
	Tons.	Valuation.	Tons.	Valuation.	Tons.	Valuation.
Round logs	140,000	$700,000	325,000	$1,625,000	154,350	$588,813
Hewn and sawn timber	3,200	24,000	10,000	75,000	7,648	28,680
General merchandise	10	450	10	1,000	....	....
Crossties	18,000	90,000	....	....	17,063	68,253
Total	161,210	314,450	335,010	1,701,000	179,061	685,746

It is impracticable to obtain the ton-miles.
Principal destination of the above: Pascagoula and Moss Point, Miss.

65. *Conclusion.*—It is not believed that a navigable low-water channel could be formed without great expense, nor is there any prospect of its profitable use.

This section of the river is, therefore, not worthy of further improvement, the only navigation at all likely to use the improved stream being rafting of logs and timber, which even now does not use to the fullest extent the facilities available.

CHICKASAHAY RIVER (FROM ITS MOUTH TO BUCATUNNA).

* * * * * * *

100. *Summary.*—Summing up the conclusions of the preceding report, it is recommended that the names of the Leaf and Chickasahay Rivers be omitted altogether from the title of the appropriations; that no work be hereafter done upon them * * *.

C. Keller,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., April 3, 1916.

To the CHIEF OF ENGINEERS:

1. Forwarded.

2. The improvement of these three rivers has been under three separate projects, but on all of them the work for many years has been maintenance only. The district officer, in report dated December 15, 1915, on preliminary examination of the Chickasahay River from its mouth to Shubuta, stated that in his opinion further expenditure of public funds at this time for the improvement or maintenance of this locality is not justified, in which opinion the division engineer concurred. The reasons on account of which further improvement or maintenance of Leaf River is not justified appear equally strong.

3. These rivers are available for rafting in high water in their present condition. There is no other navigation at present nor, in my opinion, is such navigation prospective. I am informed that these rivers are not used for rafting when the stage of water at the gauge on Merrill Bridge is less than 14 feet, for the reason that nearly all the timber rafted comes out of the small tributaries of these rivers. At rafting stages snags and similar obstructions give little trouble. The Pascagoula River has some commerce other than rafting and is used for rafting at lower stages than the Leaf or the Chickasahay.

4. The district officer recommends in the last paragraph of his report that the names of the Leaf and Chickasahay Rivers be omitted altogether from the title of the appropriation. I concur in this recommendation, provided the three rivers are considered as one improvement. If considered as separate improvements, I recommend that the projects for improving the Leaf and Chickasahay Rivers be abandoned.

* * * * * * *

J. C. SANFORD,
Colonel, Corps of Engineers, Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors, see p. 2.]

PUBLIC NOTICE RELATIVE TO PROPOSED ABANDONMENT OF PROJECT FOR IMPROVEMENT OF LEAF RIVER, MISS.

WAR DEPARTMENT,
THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
SOUTHERN BUILDING,
Washington, D. C., May 12, 1916.

To whom it may concern:

The river and harbor act approved March 4, 1915, contains the following item: "And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

In compliance with this provision of law, an examination has been made of the project for the improvement of Leaf River, Miss., and it appears from the information now available that this project should be abandoned because of the small commerce other than rafting and the impracticability of providing an effective navigation at justifiable expense.

Before taking final action in this matter, an opportunity will be given interested parties to submit, within a period of two months from the date of this notice, statements and arguments bearing upon the necessity and advisability of the United States continuing this improvement. Communications should be addressed to "The Board of Engineers for Rivers and Harbors, Southern Building, Washington, D. C." Should a hearing be desired, this can be arranged by correspondence with the board.

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

LETTER OF MR. F. B. MERRILL.

Merrill, Miss., May 13, 1916.

GENTLEMEN: Have been interested in sawmill at this place 15 years. Merrill is located about 1 mile below the junction of the Leaf and Chickashay Rivers, which make the Pascagoula River. The Leaf River project is ridiculous, as the majority of months in the year you can't float a single log or skiff. Nearly every high water changes the sand bars in river. The timber along Leaf River is practically all cut out. The only way to give navigation from here to Hattiesburg is to discard river for most of distance and build a canal.

Yours, truly,

F. B. MERRILL.

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

LETTER OF BEAR CREEK MILL CO.

Leakesville, Miss., May 15, 1916.

DEAR SIRS: We have your notice of the 12th, and note contents. In reply will state that we think there should be some improvements made on Leaf River and also Chickashay, as there is thousands of dollars worth of business done on these two rivers. This business goes through Moss Point, but is generally towed from there to Gulfport, and Gulfport gets the credit for the business, whereas Pascagoula would get it and could get it as soon as the channel is deepened some. If the Government could get at the facts in the matter we are satisfied they would improve Chickashay and Leaf Rivers and also the harbor of Pascagoula, as there is more business originating there that Gulfport gets than what Gulfport controls outside of it.

Yours, truly,

BEAR CREEK MILL CO.

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

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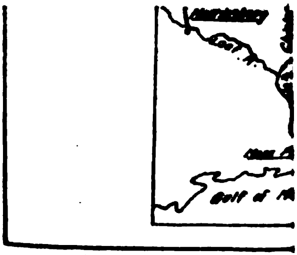

THE NORRIS PETERS CO., WASHINGTON, D. C

64th Congress, 2d Session. } HOUSE OF REPRESENTATIVES. { Document No. 1724.

WEST (WESTICUNK) CREEK, N. J.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF WEST CREEK, N. J.

December 11, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

War Department,
Washington, December 9, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 6th instant, together with copies of reports from Maj. E. N. Johnston, Corps of Engineers, dated October 30, 1915, and June 30, 1916, with maps, on a preliminary examination and survey, respectively, of West Creek, N. J., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, December 6, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of West Creek, N. J.

1. There are submitted herewith for transmission to Congress reports dated October 30, 1915, and June 30, 1916, with maps, by

Maj. E. N. Johnston, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act approved March 4, 1915, of West Creek, N. J.

2. West Creek has a length of about 7 miles and empties into the northern part of Little Egg Harbor. The head of navigation and of tidal influence is at a fixed highway bridge which crosses the stream 3⅛ miles above the mouth. The public landing of the town of West Creek is located about three-eighths of a mile below the bridge, and extends for a distance of about 1,500 feet along the right bank. About 1½ miles below the upper end of the public landing, the stream widens out and shoals to less than 2 feet. The desire of navigation interests is to have a 5-foot mean low-water channel, of practicable width, from the bay outside the mouth upstream through the shoal area. The cost of providing a channel of this depth, 50 feet wide, is estimated at $10,700 and $1,000 annually for maintenance. The district officer states that West Creek is a feeder of the inland waterway of the State of New Jersey, and he is of opinion that if the improvement is undertaken it should be done by the State of New Jersey, unless the United States should take over and maintain the inland waterway, as a result of an investigation authorized by the river and harbor act of July 27, 1916, with this object in view. Under existing conditions, however, he believes that West Creek is not worthy of improvement by the Federal Government. The division engineer concurs in this opinion.

3. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated November 14, 1916, expressing the opinion that it is not advisable for the United States to undertake the work, because Tuckerton Creek, near by, is improved, has rail connections, and thus affords an outlet for the commerce of Little Egg Harbor, so that the anticipated benefits to the general public do not appear to warrant the expense of the improvement desired.

4. After due consideration of the above-mentioned reports, I concur in the views of the Board of Engineers for Rivers and Harbors and therefore report that the improvement by the United States of West Creek, N. J., is not deemed advisable at the present time.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

The Board of Engineers for Rivers and Harbors,
November 14, 1916.

To the Chief of Engineers, United States Army.

1. The following is in review of the district officer's reports authorized by the river and harbor act of March 4, 1915, on preliminary examination and survey of West Creek, N. J.

2. West Creek has a length of about 7 miles and empties into the northern part of Little Egg Harbor. The head of navigation is

marked by a fixed bridge at the village of West Creek, 3⅛ miles above the mouth. For a distance of about 1⅜ miles above the mouth the depth is generally less than 2 feet. Above this shoal reach the depth is 2 to 4 feet up to the public landing at the edge of the village. The inland waterway of New Jersey passes through the bay close to the mouth of the creek. The mean tidal range is about 0.3 feet at the bridge and 1.8 feet at the mouth.

3. The commerce of the locality consists of oysters, clams, fish, crabs, salt hay, timber, cordwood, farm products, fertilizer, and other commodities, valued at $324,043. The amount of tonnage is not given. The business is necessarily handled by boats of small draft.

4. The improvement desired is a channel through the lower shoal 5 feet in depth and of navigable width. It is estimated that a channel 5 feet deep and 50 feet wide will cost $10,700 for first construction and $1,000 annually for maintenance. The district officer is of opinion that such an improvement as a feeder of the inland waterway should be undertaken by the State of New Jersey and that if the Federal Government assume the maintenance of this waterway as a result of the examination authorized by the river and harbor act of July 27, 1916, West Creek as a tributary should, logically, be improved by the United States. As such action has not been undertaken, however, the district officer reports the locality as unworthy of improvement by the Federal Government at this time. The division engineer concurs in the views of the district officer.

5. Interested parties were duly informed of the tenor of the district officer's report and at their request a hearing was given at the office of the board on October 17, 1916, which was attended by a delegation from the locality.

6. The minimum improvement that would materially better present conditions and meet the desires of local interests is estimated to cost $10,700 for first construction and $1,000 annually for maintenance. While important to the community and of considerable value, the commerce is not large in tonnage, and it is not believed that it will greatly increase. The town of Tuckerton, about 3 miles distant, with interior rail connections, is on an improved waterway, and offers an outlet for the commerce of Little Egg Harbor, so that the improvement of West Creek would be of value principally to the people of the immediate vicinity. The resident population of West Creek in 1910 was 550. Based upon the information now available, the board is of opinion that the benefits to the general public to be anticipated from the improvement are not sufficient to warrant the expense involved, and therefore it concurs with the district officer and the division engineer in the opinion that it is not advisable at this time for the United States to undertake the work.

7. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects which could be coordinated with the project proposed in such manner as to render the improvement advisable in the interests of commerce and navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF WEST CREEK, N. J.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., October 30, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of West Creek, N. J.

1. In compliance with department letter of March 15, 1915, the following report is submitted upon a preliminary examination of West Creek, N. J., for which provision is made in section 15 of the river and harbor act of March 4, 1915.

2. West Creek, known also as Westicunk Creek, rises along the edge of the fast land in the cedar swamps of eastern New Jersey. The creek has a length of about 7 miles. A fixed bridge, carrying the State highway which provides continuous communication between New York and Atlantic City, crosses the creek 3⅛ miles above the mouth. At the bridge on the right bank is located the town of West Creek. The bridge is at the head of navigation and of tide. Above are cedar swamps and extensive cranberry bogs. The creek has a drainage area of 21.33 square miles. The range of tide is about 2 feet.

3. From the bridge downstream for about three-eighths mile the creek has a width of about 100 feet and a low-water depth of about 2 feet. This portion of the creek is not used for traffic, but is given over to the storage of boats. The following 1,500 feet of creek constitutes the public dock of the town, 700 feet of which is improved by bulkhead, all of which is open to the public free of charge. This section of the creek and the succeeding mile have a width of about 200 feet and a low-water depth of from 4 to 5 feet. At the lower end of these sections two large ditches, one from each side, join the creek, which widens out to between 300 and 400 feet and shoals to less than 2 feet, with hard bottom. This shoal is almost continuous to the bay, a distance of about 1⅜ miles. With this barrier removed, the upper creek would be opened and made available to almost all boats using the adjacent waters. The inland waterway of New Jersey from Cape May to Bay Head passes close to the mouth of the creek, and hundreds of pleasure boats from near and distant points visit and remain in the vicinity for the opportunities of fishing and gunning, for which these waters are noted. Many such boats would call at the West Creek for supplies or repairs if this shoal were removed.

4. West Creek is a very old town, having been settled in 1710. The resident population (1910 census) was 550, which is materially increased during the summer months and probably reaches 800 to 1,000. The Tuckerton Railroad, connecting with the Pennsylvania Railroad system, passes through the town and provides passenger and freight service. The creek is used for the transportation of oysters, clams, fish, crabs, salt, hay, lumber, piling, cord wood, farm products, fertilizer, fishing, sailing, and gunning parties, boat building, and repairing. The approximate annual amount of these industries is as follows:

Oysters, 98,539 bushels, at $1.30	$138,100
Clams, 8,653,800 at $6 per thousand	51,928
Fish, 320 barrels (250 pounds), at $15	4,800

Crabs, 500 pounds, at $2	$1,000
Salt hay, 900 tons, at $8	7,200
Poultry and eggs	1,000
Fruit (peaches, apples, pears, etc.)	1,000
Lumber, piling, and cordwood	10,250
Farm products	5,000
Fertilizers (seaweed, mussels, etc., from bay)	1,000
Fishing, sailing, and gunning parties	10,000
Boat building, repairs, and supplies	16,765
Labor in oyster and clam business	75,000
	323,043

Another industry of the locality is the shipping of gravel for road building, which amounts to 10,000 tons a year, most of which is now going to the vicinity of Beach Haven and other seaside resorts on Long Beach. As the rail rate is 50 cents per ton from West Creek to Beach Haven and the water rate is 30 cents, the saving would be considerable if the creek were deep enough for boats of sufficient size to carry a profitable cargo. There is a total of about 785 acres of oyster ground in the nearby bays operated from West Creek, which furnishes employment for approximately 150 men for 200 days a year. The estimated investment for this year in this industry, exclusive of boats, is $257,000. This amount is low, due to the scarcity and high price of seed oysters. There are 11 oyster and clam packing houses along the creek. There are 186 boats owned and operated in the creek, consisting of catboats, power boats, house boats, and lighters, with a total tonnage of 806, valued at $66,105, with an annual upkeep of about $11,515. West Creek was at one time a boat-building center, many large catboats and two-masted schooners having been built, but in recent years the industry has fallen off because of insufficient depth of water in the creek. There is, however, a shipyard with two marine railways in operation which does a large amount of business in repairing and overhauling boats. As will be seen, the town is practically dependent on the creek for its business.

5. A deeper channel will be of benefit to the industries using the creek and will permit of their increase by the use of larger vessels; it will benefit Beach Haven and the other seaside resorts on Long Beach, as West Creek is the nearest point by water from them and is the natural shipping point for mainland products to meet the constantly increasing demands of these rapidly growing places; and it might encourage a revival of the former coastwise trade in merchandise, coal, etc., from New York and Philadelphia, at rates much lower than rail. Those interested in the improvement ask for a 5-foot mean low-water channel about 70 feet wide on the bottom, from the 5-foot depth in the bay through the shoal stretch of river, which extends to the point of entrance of the two large ditches, a distance of about 1⅜ miles, throughout which the depth is less than 2 feet at low water. Above, to the public landing, the natural depth is so near what is asked for in the way of improvement that no work is asked for in this portion of the creek.

6. No question of terminal facilities, water power, or other correlated development is involved.

7. The cost of the desired improvement is relatively small and may be warranted by the amount of business to be benefited. It would seem, however, that the principal interests to be benefited are local.

West Creek is really a feeder of the inland waterway already constructed by the State of New Jersey, and if any improvement in this feeder is required I believe the improvement should be made by the State rather than by the Federal Government.

8. I therefore do not consider West Creek as worthy of improvement by the Federal Government at the present time.

9. A sketch[1] submitted herewith shows the location of West Creek.

E. N. JOHNSTON,
Major, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER,
EASTERN DIVISION,
New York City, November 5, 1915.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

Concurring in the views and recommendation of the district engineer officer.

W. M. BLACK,
Colonel, Corps of Engineers.

[Third indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
November 23, 1915.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. As a result of the district officer's notice of unfavorable report, parties in interest requested a hearing which was given at this office to-day. A record of the hearing is sent herewith. The board recommends a survey in order to determine the extent and advisability of the improvement.

For the board:

JOHN BIDDLE,
Colonel, Corps of Engineers,
Senior Member Present.

SURVEY OF WEST CREEK, N. J.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., June 30, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Report on survey of West Creek, N. J.

1. In accordance with the instructions contained in department letter dated November 30, 1915, the following report upon the survey of West Creek, N. J., is submitted.

2. The field work of the survey was done in April last and extended from the fixed highway bridge at West Creek to the channel of the inland waterway of New Jersey in the bay outside of the mouth, a distance of 3½ miles.

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[1] Not printed.

3. Tidal observations were made at the highway bridge; at the oyster houses about three-fourths mile downstream from the bridge; and at the mouth of the creek, 3 miles distant from the bridge. During the survey, at the bridge the mean range of tide was found to be 0.2 foot with an extreme range of 0.4 foot, thus determining the bridge to be the head of tidal influence. The width of the creek at this point is 30 feet. At the oyster houses and at the mouth of the creek the mean range was found to be 1.9 feet and 1.8 feet and the extreme range was found to be 2.4 feet and 2.6 feet, respectively. The ranges at the oyster houses and at the mouth are practically the same. The high and low water widths at the oyster houses and at the mouth are, respectively, 90 and 75 feet and 450 and 300 feet. Tidal influence diminishes to practically nothing in the three-fourths mile between oyster houses and the bridge.

4. The public dock extends for about half a mile along the right bank of the creek from the point where the public road approaches close to and then follows along the creek bank to the oyster houses and the termination of the road. The three-eighths of a mile of creek above the public road has a controlling depth of but 1 foot and is used only for the storage of boats. The bottom is sand and gravel.

5. About 1½ miles below the upper end of the public dock, two large tributary ditches enter West Creek, and the sections of creek above and below this point differ materially. Above, the creek is much narrower, has a muddy bottom, and the depth of water is somewhat greater. The muddy bottom is cut by the propellers of the motor boats and the naturally greater depth permits the easier movement of boats.

6. Between the ditches the creek widens out suddenly to three or four times the width above, with a much less depth, and so continues to the mouth; moreover, the bottom is hard and the propellers can not cut it. This entire reach to the mouth is shoal and forms the principal barrier to the free movement of navigation. It is this portion of the creek that those interested in it are particularly anxious to have improved. The remainder of the creek up to and along the public dock offers no obstacles to the free movement of the class of boats now using these waters. The desire of navigation interests is to have a 5-foot mean low-water channel, of practicable width, from that depth in the bay outside the mouth upstream, through the hard obstructing bar to the point where the two large tributaries, North and South Creeks, enter. The further extension of the improvement to and along the public dock would give added facilities and probably invite a larger class of vessels to do business in the stream.

7. The currents of the creek, except at the extreme upper end, are sluggish, and there is very little, if any, sediment carried by the waters. The marsh, or meadow lands, bordering the creek have a general elevation of from 1 to 1½ feet above mean high-water level.

8. As the information is at hand, estimates of the cost of improving all three of the sections of the stream herein discussed have been made. The dredged material can readily be deposited upon the adjacent meadows, and the owners thereof have expressed their willingness to permit such use of their lands.

Estimates.

1. Channel 5 feet deep at mean low water and 50 feet wide from 5 foot depth outside the mouth upstream to North and South Creeks, 7,820 feet.

Dredging 48,580 cubic yards of material at 20 cents	$9,716
Add for engineering and contingencies about 10 per cent	984
	10,700

2. Channel 5 feet deep at mean low water and 40 feet wide from North and South Creeks to upper end of public dock, 7,870 feet, including a turning basin about 80 by 100 feet.

Dredging 45,410 cubic yards of material at 20 cents	9,082
Add for engineering and contingencies about 10 per cent	918
	10,000

3. Channel 5 feet deep at mean low water and 40 feet wide from public dock to the highway bridge, 2,070 feet.

Dredging 15,780 cubic yards of material at 20 cents	3,156
Add for engineering and contingencies about 10 per cent	344
	3,500

9. It is estimated that the annual maintenance for the whole creek will cost $2,500—$500 for the uppermost section and $1,000 each for the two lower sections. As the outer section of creek, between the bay and the North and South Creeks is the portion actually needing improvement to give relief to existing business and as its condition is bad throughout, the entire section should be improved in one operation. If it should be decided to improve more of the creek, the other sections could readily wait upon future authorization and appropriation.

10. The cost of improving the outer section, $10,700, appears to be reasonable compared with the amount of existing business, $323,043, stated in the report upon the preliminary examination. The prospect for increase of commerce is excellent and the use of the inland waterway of New Jersey is constantly increasing and the near-by shore resorts are developing and growing. No additional statistics were obtained.

11. In my opinion, West Creek, as a feeder of the inland waterway of New Jersey, should be improved, if the work is undertaken, by the State of New Jersey. The pending river and harbor bill provides for a preliminary examination of the inland waterway. If the examination results in the Federal Government assuming the maintenance of the waterway, then, West Creek, as a tributary, would also be in line for improvement by the United States. As this action has not yet been taken, I am of the opinion that West Creek is not worthy of improvement at present by the Federal Government.

12. The physical characteristics, the commerce of the creek, and other correlated matter, were described in detail in the report upon the preliminary examination to which attention is invited.

E. N. Johnston,
Major, Corps of Engineers.

OFFICE OF DIVISION ENGINEER, EASTERN DIVISION,
Baltimore, Md., August 5, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

Forwarded, concurring in the views of the district engineer officer.

W. V. JUDSON,
Lieutenant Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors on survey, see p. 2.]

HEARING BEFORE THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS IN REFERENCE TO WEST CREEK, N. J. (ACT OF MAR. 4, 1915).

NOVEMBER 23, 1915.

Col. Biddle, Col. Winslow, Col. Taylor, Col. Newcomer, and Col. Flagler were present.

Messrs. Joseph B. Cox and Frank Holman appeared before the board with reference to the above subject.

Col. BIDDLE. The situation is known to you. There is no need of going over what you are here for. It is the question of West Creek, N. J., and you have the report of the district officer.

Mr. HOLMAN. We have a letter from him stating why he did not approve.

Col. BIDDLE. We shall be very glad to hear any statements that you might care to make.

STATEMENT OF MR. FRANK HOLMAN.

Mr. HOLMAN. Gentlemen, I would just like to tell you, in the first place, that we find here in our communication from Mr. Johnston that he disapproves of the improvement on the ground that the improvement is local and that the interest to be served is local.

I should like to show you gentlemen at the very start just what our contention is. We have a creek two miles and a half long. One-half of the creek is all right. I will not take up any of your time on that. That has been understood from the beginning.

With respect to this particular mile and a quarter or thereabouts—I have not measured it, but it is about a mile or a mile and a quarter—we start in at the upper end of the creek and go down from our homes out to the bay, and when we get halfway down in the creek we are stalled. We have to lie there until the tide rises or turn around and go back home.

We are asking for a 70-foot channel 5 feet deep.

Mr. Johnston says that the principal reason he disapproves of this improvement is that it is local. I will admit, and my colleague Mr. Cox is willing to admit, that the interest is local; it could not be otherwise, and yet we are going to show you that it is not all local.

The different industries there make something over $300,000 a year, and among those industries is the oyster industry. We start out every year with the expenditure of thousands of dollars that we spend all the way from Rhode Island to North Carolina for seed. That is brought in here and planted. Then, after we get the ground planted and when the fall comes, the oysters are taken up and shipped, and the report here is that there is $138,000 a year which comes through our creek in oysters alone, which go out to feed all of our section—Pennsylvania, New Jersey, and New York. I could not say whether they go anywhere else or not. I am a shipper myself, and I know they go to those three States.

On account of this mile and a quarter in such shallow water we are compelled to use such light-draft boats that often our dredging has to be done by hand. We go out and dredge by hand in these light-draft boats. I suppose you gentlemen do not understand what that means. You throw this dredge overboard, and instead of having power to pull it in you do it by hand, and it is very hard work. It is a more economical way than by tongs, but it does not in any way compare with using power. The boats lose lots of time on account of this shallow water. In bad weather, too, the boats being of such light draft will not stand the seas there. So we feel that we are heavily hampered in that particular.

Another bad feature about the matter is that the creek is so shallow that in the wintertime, when the creek freezes up, the ice freezes to the bottom, and then as the tide rises the bay will open and the upper half of the creek will open and this part of the creek will stay frozen up from four to six weeks at a time. If we have boats out in the bay, if we can harbor them somewhere, we can get them up to the ice, but we can not get them over the ice, and we are terribly handicapped in that particular.

There is a great demand, gentlemen, coming from New York and Pennsylvania and throughout New Jersey for oysters, and you can readily see that the interest is not entirely local. While I, as an oyster planter myself, am going to derive benefit from it if this is carried out, and the more benefit I can get from it the more I can increase my business, it is also going to help the whole country. Is not that the idea—that every little place makes up the big place; that a number of small places make up this great United States? And so we feel that in that particular it is not local in the oyster business alone.

And then come clams, crabs, and fish. I will not take up your time in going over this. I will mention salt hay. That is another great industry. We have lots of hay there, and there are hundreds and hundreds of tons brought up our creek, and everybody in bringing hay up and down the creek is handicapped. No longer ago than last Tuesday a week ago, about one of the largest hay shippers we have there was stalled. Two boats were stalled there, and stayed there until along in the middle of the night, until the tide had raised sufficiently to get out of this shoal bottom.

Col. Biddle. How much tide is there there?

Mr. Holman. I do not think there is over a foot and a half.

Col. Biddle. I mean, what is your raise of the tide there?

Mr. Holman. About 2½ feet, when the tide is running normally.

This salt hay, gentlemen, is shipped all the way from Massachusetts to Ohio. I consulted just the other night a big shipper who shipped this hay to find out just where he shipped it, and he informed me that he ships it throughout this section from Massachusetts to Ohio. Salt hay, gentlemen, is used in the manufacture of iron pipe, in potteries, and so on, and it seems to be one of the necessities of life. We are supplying all that we are able to supply under these conditions. The demand is for more than we can get. If the creek was in a different condition we could supply more.

Poultry, eggs, fruit, lumber, farm products, fertilizer, and so on, amount to a whole lot of money. The fertilizer is brought up the creek and spread out and carted back over this creek. It is the only way we have to get to Atlantic City or to Beach Haven.

The fish industry is estimated to amount to $10,000 a year.

Gentlemen, one of the meanest features about this is that we have parties that come to West Creek all the way east of the Mississippi River, and they will come down in the morning, all ready to go out for a day's sport on the bay. We get their money, and we get them down the creek until we come to this shallow water, and there we are stalled, and either we have to lay there with these men, women, and children, in the heat and among the mosquitoes, and so on, or turn around and go back home. They go home disappointed and sore, and we are out that much—all on account of that creek. Therefore we feel that inasmuch as these people come from so far away, inasmuch as they come there seeking pleasure, and we can give them pleasure as they claim they can find nowhere else, we are justified in asking the Government, through this board, for aid.

Take the boatbuilding, repairs, and supplies, which is estimated to amount to $16,765. That money is spent from the Atlantic to the Pacific in engines that we buy, in oil and gasoline, and parts, the different repairs that we have to have—they are bought all the way from the Atlantic to the Pacific, and that money is spread out, and we have to go out in the first place and bring them up over this shallow water up this creek, in order to meet these bills and pay those people that are manufacturing engines and giving us oil and gasoline and so forth.

Then the labor from the oyster and clam business. The labor amounts to $75,000 a year, and that $75,000 a year is principally taken off by poor people that are working for their living, receiving a wage of $2.50 a day. Among that class of people they get $2.50 a day, and they spend $2.50. If you should go to the post office in West Creek and ask the postmistress how much of that money went out to Philadelphia and New York and out West to a number of different places, the principal places where stuff is bought, it would certainly surprise you for her to tell you how much money goes out of our place that goes everywhere, of that $75,000 a year that is spent far and near.

So, gentlemen, we feel it is not local. We are glad to admit that we are going to be benefited by it; we hope that we will be, but we contend that it is not local. I feel that we are just a little feeder of this great United States, and we are doing our part to the very best of our ability, and at this day and age of the world we want to increase our business. I am a young man in the oyster business. I am doing all that I can, and my partner and myself are doing all that we can do under the conditions and circumstances; and if the conditions were different we could do more. We could have larger boats, and we could handle our oysters more cheaply. When we hire men we would get a good day's work. They get the pay just the same now, and make a half or two-thirds of a day. You have to pay them for the day, and that is a terrible handicap.

Another thing, gentlemen, that Mr. Johnston says in his report, is that West Creek is really a feeder of the coast line waterway, and if any improvement in this feeder is required, it should be made by the State rather than by the Federal Government. We want to combat that. The State of New Jersey has never done any of this kind of work. We will admit that she has made an effort to be connected with that waterway which runs near our creek. In fact, I know it runs nearer our creek than any other creek along the coast. Yet she has not done any of that kind of work, and we are not looking for her to do it. We think we are justified in appealing to the Government for aid, as the Government is accustomed to doing this kind of work, and we felt that if we could show you the reason and show you that we were doing the business there to justify the expenditure of that amount of money, we were justified in coming to the Government and asking the Government for aid. All that we are asking for is with respect to that mile and a quarter right there [indicating on the map], 70 feet wide and 5 feet deep.

If any of you had been down there yesterday and gone down our creek I would venture to say that you would have found lots of places where there was not 6 inches of water, when the wind blows the tide out. Everyone was planning not to do anything until Monday because the tide would be so low that they could not get in or out.

That is our situation, gentlemen, and we are willing to leave the matter with you and we should like to have you consider it, and we certainly should like to have a delegation come down there with us and look the matter over. We believe that if you went down there and looked the matter over and saw it as it is, you would have no hesitancy at all in giving us this appropriation.

Col. **Newcomer.** Are there any tolls charged there by the State?

Mr. **Holman.** No tolls, no, sir; all free.

Col. **Flagler.** Do you float any of the oysters from West Creek down there?

Mr. **Holman.** Yes, sir.

Col. **Flagler.** How far is it from the mouth of West Creek to the mouth of Tuckerton Creek?

Mr. **Holman.** I should say 6 miles.

Col. **Flagler.** Tuckerton Creek is improved now and in good condition?

Mr. **Holman.** Yes, sir; improved and in good condition.

Col. **Flagler.** Could not all of this oyster and clam business be handled by Tuckerton Creek to the railroad?

Mr. **Holman.** No, sir; it could not.

Col. **Flagler.** Why not?

Mr. **Holman.** Not at all. We would have to leave our homes and travel over this 6 miles of bay back and forth to get out.

Col. **Flagler.** I understand that it would take away from the commerce of West Creek?

Mr. **Holman.** Oh, yes.

Col. **Flagler.** But I mean as far as the oystermen are concerned, could not they arrange it so as to handle their output by Tuckerton Creek?

Mr. **Holman.** Yes, it could be done, but I suppose it would cost one-third, if not as much more again, to do it.

Col. **Flagler.** As much as that?

Mr. **Holman.** Yes, sir. It would mean that if we were compelled to do that we would have to go out of business. We could not do it. We would have to go out of business.

Col. **Newcomer.** There are other parties doing a similar business on Tuckerton Creek now?

Mr. **Holman.** Oh, yes. At Tuckerton they have the same conditions. They go to the nearest good grounds and gather the stuff and take it up the creek. If I had to go up Tuckerton Creek, it would take me two hours, whereas I can do it now in one-half hour. It would take at least two hours to do it, whereas I can go on our grounds in a half hour.

If you have any questions that you desire to ask, I should be very glad indeed to answer them. That is the argument that we have to put up. That is all we have to say. That is our contention.

Col. **Biddle**. I think you have made it very clear.

Mr. **Holman**. That is what I have tried to do, and if there are any questions that you would like to ask about the matter we would only be too pleased to answer them.

Col. **Biddle**. I think everyone feels that he understands the situation pretty well. I do not think there will be any questions. Are there any papers that you want to leave with us? We would be very glad to have them and consider them.

Mr. **Holman**. I would like to say that all the papers we have are just a carbon copy of the report and the data that were presented to Mr. Johnston.

Col. **Biddle**. We have that.

Col. **Flagler**. All of the figures that are quoted are exactly the same as we have here.

Mr. **Holman**. We have not anything new; we went over the matter thoroughly and tried to get the facts in just as good shape as we could get them. We made up a report, and we do not want to add anything to that; we do not want to increase the figures.

Col. **Biddle**. We are very much obliged to you, gentlemen.

Mr. **Holman**. We thank you very much for the hearing, gentlemen.

Mr. **Cox**. I hope you will act favorably.

October 17, 1916.

Col. Abbot, Col. Winslow, Col. Shunk, and Col. Flagler were present. Col. Taylor and Col. Newcomer joined the hearing later.

Mr. Joseph B. Cox, Mr. Oscar Parker, Mr. Frank Holman, Mr. William H. Copperthwaite, and Mr. John T. Grey, representing the Board of Trade of West Creek, N. J., appeared before the board in reference to the above subject.

STATEMENT OF MR. FRANK HOLMAN.

Mr. **Holman**. Gentlemen of the board, we are the representatives of the Board of Trade of West Creek, N. J. We are here to-day in behalf of that point. We were down here in November last with reference to the survey of West Creek. The application for the survey was duly granted, which we appreciate very much.

We were notified, after the survey was made, that Mr. Johnston, the surveyor of our district, reported adversely on it, stating that the interest was local and that therefore he would not recommend the appropriation.

So we are here to-day appealing from that recommendation to you gentlemen, and we understand, also, that the reason he reported adversely on this work was because the interest that it benefited was local. We are here to-day to try to prove, if possible, that the interest to be benefited, while it is local, to be sure—we will not deny that—is more than local; we feel sure that the local interests will be benefited, but the interests to be benefited are not entirely local.

As we tried to prove before this board last November, and as I feel that we did prove, the interest to be benefited is no more local than it would be anywhere else.

The oyster industry alone is important. When we buy a bushel of oysters we have to send somewhere else to get the seed. Oystering is our principal industry, or one of the principal industries. When we buy a bushel of seed we usually send to Long Island, and we pay on an average of 65 cents for that bushel of seed. We bring it down there and plant that bushel, and after they are planted, from one to three years after, we take that bushel of oysters up, and then we hire local help, for which we pay about 25 cents a bushel. That is what we pay to get it ready for market. We sell the oysters, and the profit we derive from them we take to ourselves, of course. A bushel of oysters is probably worth $1.50 when it is grown. The profit that we get from the oysters we put into our boats and houses and engines and dredges, etc., and of that amount of money every cent of it has to go out of the town.

I see by the report that the board of trade made to this body last November that the value of our boats and engines, etc., is estimated at something like $11,000—that is, per year. Of that $11,000 every cent has to go out of our community, every cent of it, and is spread all over the United States. We do not produce anything there in that line; we are not a manufacturing district, and we do not produce anything of that kind. The $11,000 is the profit from the proceeds of the sales of the oysters, and to keep the oyster industry alive we have got to send that money away. We contend that the more money we can make in West Creek and the better facilities we have for making it the more money we have to send away; and, therefore, we contend that we are just a little feeder, or a small part of this great United States. That is the way we feel. We feel that we are doing our part, the very best we can, toward feeding the whole community, buying the products of the manufacturers, and selling the products of our shores—this salt hay and oysters and clams, etc.——

Col. SHUNK. I would like to ask a question. You speak of the price of seed oysters being 65 cents per bushel.

Mr. HOLMAN. Yes, sir.

Col. SHUNK. And of the price of oysters being $1.50 a bushel. How many bushels of oysters does a bushel of seed make?

Mr. HOLMAN. That depends largely on the size. The oyster I had in mind was about 400 to the bushel. This seed is usually put down in the spring and taken up in the fall, put down in April, and we begin taking it up along about this time of the year.

Col. SHUNK. It makes more than 1 bushel of oysters?

Mr. HOLMAN. Yes, sir; about 250 culls will make a bushel, and 150 to 200 plants will make a bushel; so we figure it is about $1.50 for that 65 cents in this way. That is the way we estimate it.

The salt hay, gentlemen, that comes up, we ship that to our agent in West Creek, and it goes all over the States of New Jersey, Massachusetts, New York, Pennsylvania, Ohio, Delaware, Maryland, and West Virginia, and the principal part of the hay—not all of the hay, but the principal part of it—comes up over that creek. The creek last year, when the surveyors were down there—I think it was this last spring when the survey was made—measured about 2 feet. I think I said here last November before this board that the depth of the water at mean low water was 18 inches. When the surveyors were down there and measured it accurately they found it was about 2 feet. We were interested in it and helped the surveyors, so that we became very familiar with the work that they did, and they found there was about 2 feet of water in our creek at mean low water; that is, at the mouth of the creek.

The creek is divided up into three sections, as the surveyors explained to us. The first section goes from the bridge, the main shore, right down to about three-quarters of a mile; then the next section goes from there down to what we call north and south, or the lower end of the next division, which is about a mile or a mile and a quarter, or something like that, at a rough estimate. I do not know just what the figures are, but it is something like that. But that section we are not asking any improvement on now. We have 3 feet, at least, of water there now, and we have never had any trouble there. On down in the next section of the creek, which is about 1¼ or 1½ miles, as near as I can estimate it, is where we are hampered. The first section of the creek we do not use in our industry; we can get along without that, as it is. The second section is all right. The third section is where we are hampered, and that is where we are asking you gentlemen to improve it and consider it in accordance with the recommendation of the appropriation to deepen that third section. The third section is 1¼ or 1½ miles, or somewhere in that neighborhood. That section, at the best, at ordinary low water, is 2 feet. I said 18 inches before; that was guesswork; the surveyors found 2 feet. In the spring of the year and when we have our northwesters, which we have lots of, that water will go down to a foot, and in extreme times we have known it to go down to almost nothing. A foot is not anything out of the ordinary in a hard northwester. During that time we are completely hampered. We can not do anything in the oyster business or the product business or anything else. If you are in the bay you have got to stay there, and if you are up in the town attending to that end of the business you have got to stay there until the tide rises sufficiently so that you can get in and out over this mile and a quarter or mile and a half. It may be a little more or a little less, but that is what we would estimate it at. That is the part of the creek that we are asking to have deepened.

When we were here in November we asked for 70 feet—a channel 70 feet wide and 5 feet deep in this particular section. As we worked with the surveyors and saw them work and thought more about it, we came to the conclusion that we would be perfectly satisfied with a 50-foot channel, as the sailboats are about all gone, and we have only three or four, probably, in the town that do not have power in them, and we concluded afterwards that we would be perfectly satisfied with a 50-foot channel 5 feet deep, because that would allow power boats not having to tack to pass at least three abreast, and that would be all sufficient. We would be perfectly satisfied with that. We feel that that would cut the cost down, and we figured out the best we could, according to the prices charged for that kind of work in that locality, as near as possible, that it would be about $12,000 for a 70-foot channel; but as we have taken off 20 feet we think we are not asking any more than we absolutely need, and we feel that the work can be done for from eight to ten thousand dollars.

We felt perfectly justified in coming down before this body and presenting this cost of work, and we believe that you will consider it favorably if you can understand the facts as we see them and as we believe them.

Col. **Flagler.** What was the last channel you asked for?

Mr. **Holman.** Fifty feet we are asking for now. That is what we will be satisfied with—a 60-foot channel. In November last we asked for a 70-foot channel, which we thought was what we needed then; but as we came in contact with the surveyors and saw them at their work, and as we considered the power boats, instead of sailboats, we felt that we could get along if we had 20 feet less, and it would make that much less expenditure. We do not want to ask for anything that we do not really need, as I said before.

So we are here asking you people to consider that 50-foot channel, and we will be perfectly satisfied with it at 50 feet.

As soon as you get out of the mouth of our creek, just a little ways from the mouth of the creek, you get into about 5 feet of water. I do not remember whether the surveyors went over that and measured it accurately or not, but we come into good water. It is probably just a few feet, but it is thoroughly out of the mouth of the creek when you come into this deep water. In ordinary low water, in the summer time, gentlemen, there are places down there for fishing. I find here in this report that the party business amounts to about $10,000; that is, people coming from other places down there for fishing. We have the finest fishing grounds on the Jersey coast, and we will recommend it to anybody as such. Our little town is trying to do its share of entertaining people that come down there fishing, and getting their money—that is what we are after; their money, that is sure. We want to get their money and show them a good time, so that they will come again. We are trying to do our part in that line, and for a little town like that, getting the benefit of $10,000 for three months or three months and a half, through the summer, we think it is a pretty big item, and the people are perfectly satisfied to pay it. The only reason we are hampered and can not compete with other people and do the business they do is on account of the depth of the water. We go out one day in the morning with a party and they are as happy as can be. They can almost feel the fish biting on their lines before they throw them over. Just as you get there you go aground and there you have to lay. You can imagine what a party feels like, with the mosquitos boring them. Consequently, they are going to Beach Haven, or Atlantic City, or somewhere else, going that much farther around for the sake of not going aground.

I am in that business myself, and when they get ready to go home and catch the train or take an automobile—a good may of them come down in automobiles—at 3 or 4 o'clock in the afternoon to Philadelphia or Camden, or some of those places, they say, "We have got all the fish we can, now, and we are going in." Maybe they will go aground and have to lay there until almost sunset.

Those are the conditions that we are up against, and that is why we are asking this board for this improvement. We ask you to reconsider or to consider favorably this proposition, and we would like to invite you, before you turn us down, to come down there, and we will take you out and take you over the ground, and if there are any fish running we will take you fishing, and if it is so that we can go aground, we will probably take you aground.

Of course, the party business is over now, and the fishing is over, and we are engaged in the oyster business and in the hay business and we are working to our utmost.

Here is another important thing that I wish you would consider: On account of the depth of the water in our creek our boats have to be very small and very shallow. We have to build flat-bottomed boats. Our boats are just as flat as my hand or just as flat as that paper [indicating] and we have to use about 5 or 6 horse engines with an 18 or 20 inch propeller, so that they usually draw only 18 or 20 inches of water. When you go out on your lands to dredge for oysters, so you can compete with other people having power dredges—for instance, at Tuckerton—we have got to pull those dredges by hand, and after you have done that your shoulders will be almost as bad as mine, because I have done it; so I know what it is. It is just main strength and awkwardness.

I have never seen those power dredges operated. I have never been close enough to see them operate, but they tell me that they can dump oysters on deck as fast as two men can shovel them back. We have got to sell our oysters at the same price that they sell theirs for, when it is costing them 10 cents and costing us 25. So we are losing 15 cents.

Col. **Flagler.** Why could you not market all your oysters through Tuckerton?

Mr. **Holman.** It is too far away.

Col. **Flagler.** About 5 miles from the mouth of one creek to the mouth of the other?

Mr. **Holman.** It is about 5 miles.

Col. **Flagler.** The distance is the only drawback?

Mr. HOLMAN. The distance is the only drawback. From our landing up to their landing it would take at least two hours under ordinary conditions. There is a cluster of oyster lots around the mouth of the creek—that is, West Creek. Then you go on to what is called Parkertown Creek, which is very small, and there is a cluster of lots around there, and the Parkertown people claim and use that ground. You go down to Tuckerton, and you are on somebody else's lots until you get out of the creek. If you are going to operate there at that place you have got 5 or 6 miles to go through with the small boats that we are using. Of course, if we were near Tuckerton we could use a larger boat, but with the boats that we have it would swamp us, so that we could slip out of the mouth of the creek and get our stuff and get back in again the same as Parkertown does and Tuckerton does. It would be impracticable to do business up Tuckerton Creek on account of the distance.

That is all that I can think of that there is to be said. I have simply stated the facts.

You have the report from the board of trade giving the amount of the different industries, and I believe it is something like $300,000 the amount of business done there in a year, and we feel that that amount of business being done now, with this small expenditure of $12,000 at the utmost, you would be justified in granting us this improvement, and we feel that we are justified in asking it.

Col. WINSLOW. Do you make any use in your oyster business of the inland waterway along the shores of New Jersey?

Mr. HOLMAN. No, sir; none whatever. There is one place where we go across it; that is all.

Col. WINSLOW. You cross it, but you do not ship any material by it?

Mr. HOLMAN. No material whatever.

Col. WINSLOW. What use is made of the inland waterway?

Mr. HOLMAN. For instance, when we go to Barnegat Bay, where there is a small amount of seed—it would not amount to anything at all; nevertheless we go occasionally to get seed from Cedar Creek, in Barnegat Bay; we go about 30 miles, and then we use the inland waterway.

Mr. COX. This inland waterway is also used when we get our seed from Long Island Sound, and also from Virginia.

Col. WINSLOW. But you are not urging this as a feeder for that waterway?

Mr. COX. No, sir.

Mr. HOLMAN. No, sir.

Col. WINSLOW. But as a separate and independent improvement?

Mr. HOLMAN. Yes, sir.

Gentlemen, Mr. Cox and Mr. Copperthwaite, two of the men here to-day, started in last year in the seed business, raising oyster seed, and they built a boat that draws about 4 or 5 feet of water. We have thousands of bushels of shells up our creek that they would have bought and would like to have bought to get up on their ground to raise seed there, but on account of the depth of the water they could not do it and did not do it because it would have cost them so much to transfer them in their small boats to a larger boat. They had to take their boats and go into Virginia, and they got shells there cheaper than they could get them up our creek and take chances and put them on the boats and take them down. That does not seem possible, and yet it is an absolute fact. They did that.

(Addressing Mr. Cox). How many loads have you run?

Mr. COX. Four or five.

Mr. COPPERTHWAITE. Seven thousand bushels.

Mr. HOLMAN. In this one boat; and on account of the depth of the water those shells are laying up in our meadows now. So you see, gentlemen, we are certainly handicapped. If there are any questions you want to ask some of us would be only too glad to answer them.

Mr. GREY. If some of these gentlemen could come down there and see the situation, they would not wait two minutes to grant the improvement.

Mr. HOLMAN. We do not want to make any statements that are not absolutely correct. We do not want to ask for any more than we absolutely need, gentlemen. It is a sore thing with us, and we feel that we are not asking for anything more than we need, but just as little as we possibly can. If we could get along with a 20-foot channel, 20 feet wide, we would ask for that; but we feel that 50 feet is about as narrow as we can get along with. We feel that if we can get 50 feet of water in this short stretch of a mile or a mile and a quarter, when we get out to the mouth of the creek we have still got 5 feet, and when we get up to the upper end of this 5 feet we have got 3 feet at ordinary low water, and we think we could get along with that.

Col. Flagler. Just what were those limits that you want this 5 feet over?

Mr. Holman. The lower section—if we understood the surveyors rightly, they were going to lay the creek off in three sections. Whether that is right or not I do not know, but they were talking about laying the creek off in three sections. The first section is never used in the oyster industry. That goes from the main shore right down about three-quarters of a mile, I think, or something like that, as near as I can remember about the figures that they gave us. It was something like that, I think. Then the next section goes from our first land down to what is known as North and South, which is, if I remember rightly, somewhere around a mile; and then the third section is from North and South to the mouth of the creek, anywhere from 1¼ to 1½ miles at a rough estimate. I have never measured it or seen anyone else do it.

Col. Flagler. It is 7,820 feet in the report.

Mr. Holman. I imagined it was somewhere around in that neighborhood. Then we are asking for 50 feet.

Gentlemen, here is another thing: In the wintertime that creek freezes up just as quickly as a mill pond. The bay is open; other creeks are open, but our creek is frozen up on account of its being so shallow. The mouth of the creek is 150 yards wide, at least, and then it runs up to the upper end, where we are asking the improvement, to 100 yards, and it is shallow clear across. Of course the tide, ebbing and flowing in there, while there is a whole lot of water comes in and out, it is such a wide space, and there is not much current there. When we get above this place—whether it is fresh water or whether it is the current that has run so much stronger in a much narrower space—the ice soon cuts out, but this place is frozen up, and we are bothered with that tremendously, and we feel that if we had a channel 5 feet deep and 50 feet wide the channel would have the current run in it so strong that it would clear it out and we would not be bothered with the ice the way we are now. We do not know that, but we believe that would be the case, because the tide would run out so much stronger in the channel way than it now runs that the ice would be cut out in half the time.

Col. Winslow. Do you have any difficulty with your oysters freezing at low water?

Mr. Holman. No, sir. The oysters are all dragged up the creek into this deeper water, and when the water begins to get cold they are so situated that no matter how low water gets they are still covered with water.

Col. Flagler. I would like to ask a question about this statement that was furnished by your board of trade.

Does all that salt hay go over the creek? There are 900 tons of it listed here.

Mr. Holman. I could not tell you about that. I do not know whether they estimated all of it or whether it was only a part of it. There is an awful lot of salt hay that goes over the creek. There is a whole lot that does not go over the creek. It is an important industry down in our section, shipping salt hay, and whether this amount all goes over the creek or not I am not in a position to say.

Col. Flagler. Your poultry and eggs and fruit—are those things hauled over the creek?

Mr. Holman. Not all of them.

Col. Flagler. Any of them?

Mr. Holman. Oh, yes; there are lots of them.

Mr. Cox. They are hauled over to the Beach Haven resorts, and all those places.

Col. Flagler. How about lumber? Does that go over the creek—piling and cordwood?

Mr. Holman. Yes, sir; lots of it. At West Creek on one side is salt meadows, and on the other side are woods, sawmills, and such like. There is a great demand for that over on the beach, for building purposes, and it is transported, a lot of times, by rail.

If there are any other questions, gentlemen, we will answer them if we possibly can.

I do wish to make one more statement, gentlemen, and that is that if our creek is dug out, as we hope it will be, of course, we do not want you to think that we are getting this little place dug out here, and then will ask you to dig out half of the bay; because when we get to the lower end of this section we have plenty of water there; we have 5 or 6 feet of water there at ordinary low water—all the water we want, and all we need. So we do not want you to think that this is just getting a little section improved, and then we are going to ask you after that to dig out half the bay, because that is not so. We have plenty of water as soon as we get to the lower end of this section which we speak of.

Col. Abbot. We are much obliged to you for coming here and we will give this matter due consideration.

Mr. Holman. All right, sir; thank you.

Assistant Engineer.

Major, Corps of Engineers.

ted by:

SNYDER, Junior Engineer.

by R.G.D.

File No.

House Doc. No. 1724 ; 64th Cong., 2d Sess.

House Doc. No. 1724 : 64th Cong., 2d Sess.

64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1725.

APALACHICOLA RIVER, FLA.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON REEXAMINATION OF APALACHICOLA RIVER, THE CUT-OFF, LEE SLOUGH, LOWER CHIPOLA RIVER, AND UPPER CHIPOLA RIVER, FLA.

DECEMBER 11, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 9, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 6th instant, together with copy of a report from Maj. E. I. Brown, Corps of Engineers, dated October 4, 1915, with map, and copies of supplemental reports from Maj. F. C. Boggs, Corps of Engineers, dated March 28 and June 13, 1916, respectively, relative to the project for improvement of Apalachicola River, the Cut-Off, Lee Slough, and lower Chipola River; also the project for improvement of upper Chipola River, Fla., made by them in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

NEWTON D. BAKER,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, December 6, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of Apalachicola River, the Cut-Off, Lee Slough, lower Chipola River, and upper Chipola River, Fla.

1. Under authority contained in section 14 of the river and harbor act approved March 4, 1915, there is submitted herewith for transmission to Congress report dated October 4, 1915, with map, by

Maj. E. I. Brown, Corps of Engineers, and supplemental reports dated March 28, 1916, and June 13, 1916, by Maj. F. C. Boggs, Corps of Engineers, relative to the project for improvement of Apalachicola River, the Cut-Off, Lee Slough, and lower Chipola River, and also the project for improvement of upper Chipola River, Fla.

2. The existing project for improvement of Apalachicola River provides for a channel 100 feet wide and 6 feet deep at low water in the Apalachicola River, and a channel 60 feet wide and 5 feet deep through the Cut-Off, Lee Slough, and lower Chipola River, at a total estimated cost of $87,833. The project has been completed except at Blountstown Bar on the Apalachicola, where it is estimated that an expenditure of $35,000 will be required to secure the project depth, and in the Cut-Off, where a small amount of work is required at an estimated cost of $2,400, making a total of $37,400 required to complete the project. The route by way of the Cut-Off and lower Chipola is generally followed by steamboats, and in view of this fact the district officer believes that the project should be modified to provide for a channel 6 feet by 100 feet throughout, and that the designation "Lee Slough" should be omitted. The cost of providing the increased dimensions recommended is estimated at $9,000, which, added to the amount required to complete the existing project as shown above gives a total of $46,400 required for completion of the proposed modified project. The existing project for the upper Chipola River provides for a channel 3 feet deep and 60 feet wide from Marianna to the foot of Dead Lakes, at an estimated cost of $41,000, exclusive of the cost of necessary plant. Work has been practically confined to the reach below Look and Tremble Shoals, and the project depth is available up to this point. The commerce is confined to the section below these shoals, and the district officer is of opinion that the project can be advantageously modified by eliminating the reach above them. The division engineer and the Board of Engineers for Rivers and Harbors concur in the views of the district officer.

3. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the modification of the project for improvement of Apalachicola River, the Cut-Off, Lee Slough, and lower Chipola River to provide for a channel 6 feet deep at low water and 100 feet wide throughout, at an estimated cost of $46,400 for remaining work of construction and $9,500 annually for maintenance, and that the title of the project be changed to read, "Apalachicola River, Fla., including the Cut-Off and the lower Chipola River." The estimated cost of the additional work involved in the recommended modification, $9,000, should be made available in one appropriation, and the remaining $37,400 should be provided in accordance with estimates contained in the Annual Reports of the Chief of Engineers. Legislation is also recommended authorizing a modification of the existing project for the upper Chipola River so as to provide for a channel 3 feet deep and 60 feet wide from the Cut-Off to Look and Tremble Shoals, at an estimated annual cost of $3,000 for maintenance.

W. M. Black,
Chief of Engineers United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Fifth indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
July 12, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following report on Apalachicola River, including the Cut-Off, Lee Slough, and lower Chipola River, and on upper Chipola River, Fla., is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads, "and the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. The Apalachicola River is formed by the junction of the Chattahoochee and Flint Rivers and empties into Apalachicola Bay (see accompanying map). The "Cut-Off" is a navigable connection 1⅜ miles in length between the Apalachicola and the Chipola Rivers. Lee Slough, 6$\frac{2}{10}$ miles in length, is the local name for a portion of the Chipola River below the Cut-Off. The lower Chipola, 8$\frac{2}{10}$ miles in length, is the remainder of the Chipola below Lee Slough. The Chipola empties into the Apalachicola at a point about 25 miles above its mouth. The upper Chipola River is that portion of the Chipola above the Cut-Off. For a distance of about 10 miles above the Cut-Off it broadens into a wide cypress swamp, called the Dead Lakes. At Look and Tremble Shoals, about 65 miles above the Cut-Off and 20 miles below Marianna, there is a fall of about 5 feet in a distance of 40 feet, and above this point there are numerous rock shoals, so that navigation is practically limited to the river below this point.

3. The existing project for the Apalachicola River, adopted by the river and harbor act of June 23, 1874, and extended by the act of June 13, 1892, provides for a channel 100 feet wide and 6 feet deep at low water in the Apalachicola River and a channel 60 feet wide and 5 feet deep through the Cut-Off, Lee Slough, and lower Chipola River, at a total estimated cost of $87,833. The project depths have been secured except at Blountstown bar, where the depth is only 5 feet. The completion of this work is estimated to cost $35,000. The total expenditures to June 30, 1915, amounted to $126,598.23, of which $56,997.53 was for maintenance. The present project for the upper Chipola, adopted by the river and harbor act of March 3, 1899, provides for a channel 3 feet deep and 60 feet wide from Marianna to the foot of Dead Lakes, at an estimated cost of $41,000, exclusive of the cost of plant. Expenditures to June 30, 1915, have amounted to $30,771.24 for improvement and $9,209.11 for maintenance. The work has been practically confined to the reach below Look and Tremble Shoals, and the project depth is now available up to this point.

4. The commerce on the Apalachicola River for the past three years has averaged about 140,000 tons, valued at about $13,200,000. The route by way of the Cut-Off and lower Chipola is generally followed by steamboats, as there are a number of landings on this route

and practically none by the alternative main river route, and except for some sharp points the requisite width and depth of channel are available. In view of these facts, the district officer recommends a modification of the existing project so as to make the channel dimensions 6 by 100 feet throughout. The additional cost of this work is estimated at $9,000. He also recommends the discontinuance of the designation "Lee Slough," as this is but a part of the lower Chipola. The project would then provide for a channel 6 feet deep and 100 feet wide in the Apalachicola, the lower Chipola, and the Cut-Off, at an additional cost of $46,400 (of which $35,000 is for completion of work at Blountstown and $2,400 for work in the Cut-Off), and $9,500 annually for maintenance. The division engineer concurs in the views of the district officer.

5. The commerce on the upper Chipola for the past three years has averaged about 7,800 tons, valued at $330,000, all confined to the reach below Look and Tremble Shoals. The district officer and the division engineer are of opinion that the existing project for the upper Chipola might advantageously be modified by eliminating the reach above Look and Tremble Shoals.

6. It appears from the information now available that the project dimensions for the Apalachicola River should be uniform throughout and that the dimensions proposed by the district officer are now practically available, except at one point in the Cut-Off, and at Blountstown Bar. The words "Lee Slough" are no longer applicable, and the board agrees with the district officer that they should be omitted in the designation of the project. In view of the foregoing, the board concurs with the district officer and the division engineer and recommends that the project for the Apalachicola be modified by changing the title to read "Apalachicola River, Fla., including the Cut-Off and the lower Chipola," and by providing for a channel 6 feet deep and 100 feet wide, at a cost of $46,400 (of which $35,000 is for completion of work at Blountstown and $2,400 for work in the Cut-Off), and $9,500 annually for maintenance. With reference to the upper Chipola, it is clear that the physical conditions of the reach from Marianna to the Look and Tremble Shoals are such that it is not susceptible of improvement for useful navigation at reasonable cost. Below these shoals the river is in very fair condition and the commerce is confined to this section. It therefore seems advisable to eliminate from the project all improvement above Look and Tremble Shoals, and legislation is recommended authorizing a modification of the existing project so as to provide for a channel 3 feet deep and 60 feet wide from the Cut-Off to Look and Tremble Shoals, at an estimated annual cost of $3,000 for maintenance.

For the board.

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF APALACHICOLA RIVER, FLA., INCLUDING THE CUT-OFF, LEE SLOUGH, AND LOWER AND UPPER CHIPOLA RIVERS.

War Department,
United States Engineer Office,
Montgomery, Ala., October 4, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Proposed modification of project for Apalachicola River, Fla., including the Cut-Off, Lee Slough, lower Chipola River, and upper Chipola River from Marianna to its mouth.

1. Pursuant to section 14 of the river and harbor act approved March 4, 1915, and under authority of fourth indorsement, office of the Chief of Engineers, dated May 3, 1915, the following report is submitted upon the proposed modification of the project for improving the Apalachicola River, Fla., including the Cut-Off, Lee Slough, lower Chipola River, and upper Chipola River from Marianna to its mouth.

2. The Apalachicola River is formed at the southwest corner of the State of Georgia by the junction of the Chattahoochee and Flint Rivers, which have their sources in northern and central Georgia. From the junction the river flows southerly through the State of Florida for a distance of 106 miles, and empties into Apalachicola Bay.

3. At a point 42 miles above the mouth a branch locally known as the "Cut-Off" leaves the river, and after a distance of about 1.8 miles joins the Chipola River. A portion of the Chipola River below the junction of the Cut-Off, for a distance of about 6.2 miles, is locally known as the "Lee Slough," and the remainder of the Chipola River about 8.2 miles, locally known as the "lower Chipola" River, flows into Apalachicola River at a point about 25 miles above its mouth. That portion of the Chipola River above the Cut-Off known as upper Chipola River rises in Jackson County, Fla., and flows in a general southerly direction through the northwestern portion of the State of Florida for a distance of about 125 miles to its junction with the Apalachicola River. Marianna, Fla., is located about 85 miles above the Cut-Off in Apalachicola River. That portion of Chipola River lying immediately above the Cut-Off for a distance of about 10 miles is locally known as the "Dead Lakes."

4. The existing project for improvement of Apalachicola River to obtain a channel 6 feet deep and 100 feet wide was adopted by the river and harbor act of June 23, 1874 (H. Doc. No. 241, 42d Cong., 2d sess.), at an estimated cost of $80,333. The scope of the improvement was finally extended to include the Cut-Off, Lee Slough, and lower Chipola River by the act of July 13, 1892, providing for a channel 5 feet deep and 60 feet wide, at an estimated cost of $7,500 (A. R. 1889, p. 1416).

5. The mouth of Apalachicola River in Apalachicola Bay, at Apalachicola, Fla., has a depth of 10 feet, and from thence a depth of from 10 to 12 feet can be carried through West Pass of Apalachicola Bay to the Gulf of Mexico. The available depth in the river from its mouth to the junction is 6 feet, except at Blounstown Bar, where there is a shoal on which the depth varies from 2½ to 5 feet.

In the Cut-Off, Lee Slough, and lower Chipola River, where the existing project provides for a channel depth of 5 feet and a width of 60 feet, a greater depth than 5 feet has been obtained by the process of cleaning out and removing snags and other obstructions from the channel and straightening the channel to some extent. This route provides an alternative route for steamers going up and down Apalachicola River and gives access to Cochran's Landing, Wewahitchka, Isbell's, Magnolia, Dalkeith, and Douglas, all of which are inaccessible from the main river. There are practically no landings on the main river between the point where the Cut-Off leaves and where the lower Chipola returns into the main river. For this reason the steamers have practically abandoned the use of the main river, using the Cut-Off and lower Chipola River in both their upstream and downstream trips in order to make the additional landings above referred to.

6. It is recommended that, in order to secure uniformity in the project, the project for the Cut-Off, Lee Slough, and lower Chipola River be amended to correspond to the project for the main river, namely, to provide a depth of 6 feet and a channel not less than 100 feet in width. The amount of work necessary to secure this additional depth and width is very small. In fact, it is believed that the project depth of 6 feet now exists through the Cut-Off and lower Chipola River, and a width of 100 feet can be obtained with a very slight amount of work. A few sharp points which cause considerable trouble to vessels using this route should be cut off and the channel widened at certain points.

7. It is also recommended that the designation "Lee Slough" be dropped from that portion of the river between the Cut-Off and its mouth and that the entire section be known simply as lower Chipola River. The old Lee Slough has practically disappeared and it has gradually become a portion of the channel of the main river. There is no necessity for carrying it in the future as a separate designation.

8. A revision of the project as recommended will meet all present demands of commerce and will overcome all existing difficulties to navigation. The cost of the work will be very small, and there are probably sufficient funds on hand at the present time to carry out the work as recommended herein.

9. The commerce carried on the Apalachicola River is quite large, that for the calendar year 1912 being 143,503 short tons, valued at $13,215,737; for 1913, 153,732 short tons, valued at $13,498,409; for 1914, 122,097 short tons, valued at $12,954,540. It is impracticable to state what portion of this tonnage originates or is delivered at points on the Cut-Off and lower Chipola River, but practically 75 per cent of all the tonnage is carried through this route. The principal advantage of the proposed changes will be to enable the steamboats to make better time in going through the Cut-Off. On account of its narrowness they have to slow down and in rounding many of the points it is necessary for them to stop and swing around either by lines or by "backing and filling."

10. The terminal facilities on this section of the river are rather crude. There is a small wharf at Cochrans Landing which is used by all boats on equal terms, no charges being imposed. At the other landings vessels tie up to the bank and load and unload directly therefrom. A small wharf at a station just below Cochrans, known as

the "Transfer," has been provided by the Callahan Line operating between Bainbridge, Ga., and Apalachicola, Fla., at which point they transfer freight to and from the little steamer *Chipola*, which operates on the upper Chipola River. These facilities, although crude, are sufficient for present purposes. There are other and better terminals on the main river, but as they do not pertain to the particular section under consideration no further mention will be made of them.

11. There are no questions relating to the development and utilization of water power for industrial and commercial purposes, of land drainage or reclamation, or other similar subjects which may properly be considered in connection with this improvement.

12. Summing up, the recommendations are that the project for the improvement of the Cut-Off, Lee Slough, and lower Chipola River be amended to provide for a channel 6 feet deep and 100 feet wide, to be obtained by widening and straightening the present channel, and that the designation "Lee Slough" be dropped from reference to the lower Chipola River.

EARL I. BROWN,
Major, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., March, 17, 1916.

To the DISTRICT ENGINEER OFFICER,
Montgomery, Ala.:

1. Returned for additional information.

2. E. D. 79858/216 directs a report as to the advisability of abandoning two present projects, namely, that for improving the Apalachicola River, Fla., including the Cut-Off, Lee Slough, and lower Chipola River, and that for improving the upper Chipola River from Marianna to its mouth. The foregoing report has reference only to the former of these projects. A statement is desired as to whether or not, in the opinion of the district officer, the present project for improving the upper Chipola River from Marianna to its mouth should be modified or abandoned.

J. C. SANFORD,
Colonel, Corps of Engineers,
Division Engineer.

[Second indorsement.]

OFFICE OF THE DISTRICT ENGINEER OFFICER,
Montgomery, Ala., March 28, 1916.

To the DIVISION ENGINEER, GULF DIVISION,
New Orleans, La.:

1. The existing project for improvement of upper Chipola River to secure a channel 3 feet deep and 60 feet wide from Marianna to the foot of the Dead Lakes was adopted by the river and harbor act approved March 3, 1889 (see Annual Report for 1889, p. 1416), at an estimated cost of $41,000 exclusive of the necessary plant.

2. The project is about 75 per cent completed. The project depth is available throughout the improvement from the foot of Dead Lakes to Look and Tremble Shoals, and the project width is available except at Maynards Cut and Sister Island. The maximum draft

that could be carried over the entire improvement at the close of the fiscal year ending June 30, 1915, at mean low water, was 3 feet.

3. The traffic in the calendar year 1914 aggregated 7,337 tons, valued at $352,205, being a decrease in tonnage of 2,669 tons from the commerce of the preceding year. This decrease can be accounted for by the disturbed trade conditions, and should not be taken as an indication of future premanent decrease. About three-sevenths of the traffic is carried upstream and about four-sevenths downstream. In this connection attention is invited to the statement of commerce forwarded herewith.

4. There are no wharves or terminal facilities on this stream other than natural landings, or landings at which flimsy wooden structures of the most primitive character have been constructed. These seem, however, to serve the present needs of commerce.

5. There are no questions relating to the development and utilization of water power for industrial and commercial purposes, of land drainage or reclamation, or other similar subjects which may properly be considered in connection with this improvement.

6. It is the opinion of the district officer that the project for improvement of this stream should not be modified or abandoned for the present.

F. C. Boggs,
Major, Corps of Engineers.

[Third indorsement.]

Office of Division Engineer, Gulf Division,
New Orleans, La., April 3, 1916.

To the Chief of Engineers, United States Army:

1. Forwarded.

2. The foregoing reports cover the project for improving Apalachicola River, Fla., including the Cut-off, Lee Slough, and lower Chipola River, and that for improving the upper Chipola River from Marianna to its mouth.

3. As to the former of these projects, the district officer recommends simplifying the title to read, "Improving Apalachicola River, Fla., including the Cut-off and the lower Chipola River." He also recommends that the project dimensions through the route now designated as "Cut-off, Lee Slough, and lower Chipola River" be amended to provide a depth of 6 feet and a channel not less than 100 feet in width, making the channel dimensions correspond to the project for the main river. It appears from his report that the proposed project depth now exists through the route mentioned, also the proposed project width "except at certain points," the amount of work necessary to secure the proposed dimensions being small. As to the cutting off of the few sharp points spoken of, this is apparently now authorized by section 5 of the river and harbor act approved March 4, 1915. I have personally examined the route and consider that the project dimensions should be the same on it as on the main Apalachicola River, since it is, properly speaking, the Apalachicola River so far as navigation is concerned. I concur in his recommendations regarding this project, but am in doubt as to whether formal modification by Congress is necessary.

4. The district officer's opinion, in second indorsement, that the existing project for improvement of upper Chipola River, from Marianna to its mouth, should not be modified or abandoned for the present, is concurred in.

J. C. Sanford,
Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors, see p. 3.]

COMMERCIAL STATISTICS, CALENDAR YEAR 1914.

Apalachicola River, Cut-off, Lee Slough, and Lower Chipola River.

VESSEL CLASSIFICATION.

Class.	American.	Net registered tonnage.	Passengers.
Registered:			
Steamers	6	751	15,816
Tugs	5	262	....
Unregistered:			
Barges	8	800	....
Rafts	208	....	....
Total	227	1,813	15,816

FREIGHT TRAFFIC.

Articles.	Amount.	Amount.	Valuation.	Average haul or distance freight was carried.	Rate per ton-mile.
UPSTREAM.	*Customary units.*	*Short tons.*		*Miles.*	
Brick ... number	1,000	3	$7	60	$0.011
Cement ... sacks	475	24	238	70	.0196
Cotton ... bales	10,930	2,732	491,850	50	.01
Cotton seed ... sacks	4,210	210	8,420	50	.0237
Fertilizer ... do	2,810	281	5,620	60	.01
Fruit ... crates	19,200	960	47,500	70	.0275
Grain ... sacks	38,365	2,277	95,913	80	.0225
Hay and feed ... bales	3,425	171	3,425	60	.0287
Live stock ... head	114	18	9,940	65	.0275
Lumber ... feet	1,385,500	2,771	27,710	75	.0275
Manufactured iron and steel ... packages	2,420	121	4,840	70	.03
Miscellaneous merchandise ... do	225,839	27,799	7,490,350	80	.04
Oil ... gallons	33,550	134	6,710	65	.0225
Rosin ... barrels	45,553	11,388	318,871	70	.015
Salt ... sacks	500	50	500	80	.025
Sand and gravel ... barrels	380	95	550	100	.005
Shingles ... number	1,745,500	291	6,982	85	.02375
Stone ... tons	3	3	120	100	.01
Sugar, honey, and sirup ... barrels	4,681	819	103,660	60	.03
Ties, cross ... number	6,720	604	3,360	60	.02
Turpentine ... barrels	15,184	3,226	341,640	70	.015
Wool ... bales	395	19	5,450	70	.0225
Total	....	54,596	8,973,656	....	....
DOWNSTREAM.					
Brick ... number	193,095	531	980	70	.02
Cement ... sacks	1,226	61	613	70	.0275
Coal ... tons	229	229	1,145	73	.0237
Fertilizer ... sacks	76,013	7,601	152,020	60	.02
Fruit ... crates	1,830	92	4,575	60	.0337
Grain ... sacks	34,050	2,554	85,125	70	.035
Hay and feed ... bales	2,985	149	2,985	75	.0375
Live stock ... head	76	18	3,418	60	.0375

COMMERCIAL STATISTICS, CALENDAR YEAR 1914—continued.

Apalachicola River, Cut-off, Lee Slough, and Lower Chipola River—Continued.

FREIGHT TRAFFIC—Continued.

Articles.	Amount.	Amount.	Valuation.	Average haul or distance freight was carried.	Rate per ton-mile.
DOWNSTREAM—continued.	*Customary units.*	*Short tons.*		*Miles.*	
Logs:					
Ash … feet	1,009	2	$20	73	Rafted.
Cedar … do	6,146	9	385	71	Rafted.
Cottonwood … do	637,000	955	4,915	70	Rafted.
Cypress … do	5,271,987	7,908	105,440	90	Rafted.
Pine … do	6,636,504	13,273	82,950	90	Rafted.
Poplar … do	153,619	317	2,553	100	Rafted.
Lumber … do	794,350	1,589	15,887	75	$0.0175
Manufactured iron and steel … packages	11,881	594	23,762	62	.025
Miscellaneous merchandise … do	223,772	27,237	3,320,800	67	.025
Oil … gallons	22,300	89	4,460	67	.0325
Rosin … barrels	6,583	1,648	46,151	67	.025
Salt … sacks	712	71	712	70	.0325
Sand and gravel … barrels	205	50	280	40	.005
Shingles … number	150,000	25	600	55	.025
Stone … tons	12	12	1,200	95	.01
Sugar, honey, and sirup … barrels	2,207	386	54,072	70	.02125
Ties, cross … number	255	6	128	65	.025
Timber … feet	813,769	1,628	16,275	100	Rafted.
Turpentine … barrels	2,197	2,197	49,433	67	.025
Total		67,501	3,980,884		
RECAPITULATION.					
Freight traffic:					
Upstream		54,596	8,973,656		
Downstream		67,501	3,980,884		
Total		122,097	12,954,540		
Decrease from last year		31,635	542,869		

The above decrease was due to the unsettled condition of the cotton, lumber, timber, and naval stores market. This decrease is, in all probability, a temporary one.

Number of ton-miles of freight transported, upstream	4,068,160
Number of ton-miles of freight transported, downstream	5,044,482
Total	9,112,642
Expenditures for the year on this improvement	$7,225.28
Expenditure per ton-mile of freight transported	$0.0008

Statement of commerce carried on upper Chipola River during calendar year 1914.

VESSEL CLASSIFICATION.

Class.	American.	Net registered tonnage.	Passengers.
Registered: Steamers	1	60	600
Unregistered: Rafts	65		
Total	66	60	600

Statement of commerce carried on upper Chipola River during calendar year 1914—Contd.

FREIGHT TRAFFIC.

Articles	Amount.	Amount (in short tons).	Valuation.	Average haul or distance freight was carried.	Rate per ton-mile.
UPSTREAM.				*Miles.*	
Brick......number..	7,500	21	$53	35	$0.04
Cement......sacks..	150	7	75	30	.04
Fertilizer......do....	1,200	120	2,400	35	.04
Grain......do....	11,450	859	28,625	35	.04
Hay and feed......bales..	6,845	342	6,845	35	.04
Lumber......feet..	50,350	101	1,007	30	.04
Manufactured iron and steel......packages..	1,250	63	2,500	27	.05
Miscellaneous merchandise......do....	16,931	1,693	169,800	35	.08
Oil......gallons..	4,820	19	964	35	.04
Salt......sacks..	150	15	150	35	.04
Shingles......number..	165,000	27	660	35	.04
Sugar......barrels..	175	31	4,288	35	.05
Total......	......	3,298	216,867	......	......
DOWNSTREAM.					
Cotton......bales..	22	5	990	35	.04
Cotton seed......sacks..	350	17	700	35	.04
Fruit......crates..	350	17	875	30	.04
Live stock......head..	30	2	500	30	.04
Logs:					
Cottonwood......feet..	2,268	4	17	35	(1)
Cypress......do....	1,218,598	1,827	24,370	35	(1)
Lumber......do....	4,500	9	90	25	.04
Miscellaneous merchandise......packages..	1,495	150	21,000	35	.08
Resin......barrels..	5,914	1,479	41,398	40	.04
Ties, cross......number..	1,200	108	600	25	.03
Turpentine......barrels..	1,971	419	44,348	40	.04
Wool......bales..	12	2	450	35	.06
Total......	......	4,039	135,338	......	......
RECAPITULATION.					
Freight traffic:					
Upstream......	......	3,298	216,867	......	......
Downstream......	......	4,039	135,338	......	......
Total......	......	7,337	352,205	......	......
Increase over last year......	......	......	32,413	......	......
Decrease from last year......	......	2,669	......	......	......

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[1] Rafted.

SUPPLEMENTAL REPORT RELATIVE TO IMPROVEMENT OF APALACHICOLA RIVER, FLA., ETC.

War Department,
The Board of Engineers for Rivers and Harbors,
Washington, April 27, 1916.

From: The Board of Engineers for Rivers and Harbors.
To: The Chief of Engineers, United States Army.
Subject: Additional information relative to Apalachicola River, Fla., including the Cut-Off, etc.

1. The board has given consideration to the district officer's report of October 4, 1915, on proposed modification of project for the Apalachicola River, including the Cut-Off, Lee Slough, lower Chipola River, and upper Chipola River from Marianna to its mouth, in which he makes the recommendation, indorsed by the division engineer, that the project for the upper Chipola be not modified or abandoned, but that the project for the Cut-Off, Lee Slough, and

lower Chipola be modified so as to require some additional work, for which no estimate is given. The board requests that the district officer submit some additional information as indicated below.

2. It appears that practically all work and traffic on the upper Chipola have been limited to the portion of the river below Look and Tremble Shoals. At these shoals there is a fall of 5 feet in a distance of 40 feet, and above them there are numerous rock shoals in the 20 miles extending to Marianna, which is the upper limit of the existing project for a low-water channel 3 feet deep and 60 feet wide. It would seem impracticable to improve this portion of the river at and above Look and Tremble Shoals at a reasonable cost. Information is requested as to whether there is any objection to eliminating this part of the river from the project.

3. An estimate is requested covering the cost of the work involved in the proposed increase of project dimensions in the Cut-Off, Lee Slough, and lower Chipola River, with statement of additional appropriation, if any, required for this work; also revised estimates for the cost of completion of other projects as proposed to be modified on these streams.

4. The present projects have no estimates for annual cost of maintenance, and it is requested that such estimates be given for the projects as modified. In this connection attention is invited to the much greater expenditures for maintenance in the Cut-Off, Lee Slough, and lower Chipola River than in the main river, and also to the fact that the cost of new work in the Cut-Off route has been about four times the original estimate. The total expenditures on this route, as given in Annual Report of 1915, have been nearly one-third greater than on the main river, though there is apparently some discrepancy between the figures given in the text and those in the financial summary.

For the board:

H. C. Newcomer,
Colonel, Corps of Engineers, Member.

[First indorsement.]

Office Chief of Engineers,
April 29, 1916.

To the District Engineer Officer, *Montgomery, Ala.*
(Through the Division Engineer, Gulf Division).

It is requested that the district officer furnish the additional information desired by the Board of Engineers for Rivers and Harbors as indicated in the above letter.

By command of the Chief of Engineers.

W. Kelly,
Major, Corps of Engineers.

[Second indorsement.]

Office of Division Engineer, Gulf Division,
New Orleans, La., May 6, 1916.

To the District Engineer Officer,
Montgomery, Ala.

Forwarded.

J. C. Sanford,
Colonel, Corps of Engineers,
Division Engineer.

Third indorsement.

OFFICE THE DISTRICT ENGINEER OFFICER,
Montgomery, Ala., June 13, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY
(Through the Division Engineer).

1. Returned.

2. The board's understanding is correct as regards the conditions of the upper Chipola at and above Look and Tremble Shoals. The 3-foot draft in the upper Chipola extends to the foot of these shoals, from which point to Marianna only 18 inches is available. It is not feasible at any reasonable cost to extend navigation to Marianna either by open river work or with dams and locks. In view of the lack of commerce, the district officer in 1903 recommended that work above Look and Tremble Shoals be discontinued and repeated this recommendation in later reports. This modification was also recommended by the Chief of Engineers in House Document No. 463, Sixty-second Congress, second session.

3. Necessity for navigation over this part of the river has largely disappeared, in view of the construction of a railroad from Marianna which parallels the river as far as Look and Tremble Shoals. The rafting of logs is the main commerce on this portion of the stream and this is carried on at the higher stages only.

4. I am therefore of the opinion that there is no objection to eliminating from the project that portion of the river at and above Look and Tremble Shoals.

5. The work to be done in increasing the approved project dimensions in the Cut-Off, Lee Slough, and the lower Chipola River from 5 feet deep and 60 feet wide, to 6 feet deep and 100 feet wide, would consist in widening the cut at Red Bull Bluff, at Apalachee Point, and in Lee Slough above Needle Eye, at an estimated cost of $9,000.

6. The work still remaining to be done on the present project on the Apalachicola River is dredging and jetty work at Blountstown bar, on main river, about 77 miles above mouth, the cost of which is estimated to be $35,000, and completing existing project of 5 feet deep by 60 feet wide at Red Bull Bluff in the Cut-Off, at $2,400, or a total of $37,400. The funds available on June 1, 1916, amounted to $6,853.34, which may be used for the above work. There will therefore be needed to complete the existing project in this river an appropriation of $31,000, and if the main river project is to be extended to the Cut-Off, etc., an additional appropriation of $9,000.

7. The estimates for annual maintenance under either present project or amended project are as follows:

Apalachicola River proper, project 6 feet by 100 feet:	
Snagging	$3,000
Repairing jetties, dredging, etc	3,000
Cut-off, Lee Slough, and lower Chipola River: Removing snags, overhanging trees, and dredging	3,500
Upper Chipola River: Removing snags, overhanging trees, and dredging	3,000

There will in addition probably be an exceptional maintenance charge of about $12,000, the year following the completion of work at Blountstown bar, to cover refilling jetties and correcting same in the light of results, but this exceptional charge will probably be for one year only.

8. The only explanation which can be made of the excess cost of new work in the Cut-Off, etc., is that the original estimate was based on a misconception of the work to be done. The records do not show the details of the original estimate and it is therefore impossible to state the particular points where discrepancies occur.

9. The discrepancy between the cost of maintenance on the main stream and in the Cut-Off is due to the fact that the former is a wide stream with few trees overhanging the channel, and practically no points to be cut off, while the channel through the Cut-Off is narrow and is considerably obstructed by overhanging trees, whilst the sharp bends and the use of the Cut-Off by larger boats has necessitated dredging at many points in order to ease these bends.

10. The discrepancy between the figures in the report and those in the financial summary is due to the fact that the $13,000 noted in paragraph "Previous projects" as having been spent between 1828 and 1831, was included in the financial summary but was apparently not included in the total expenditures given in paragraph "Condition at the end of fiscal year."

11. The figures given herein are as accurate as can be obtained from the records. No detailed survey has ever been made of this stream nor any local progressive surveys from which only could be obtained an accurate idea of the changing conditions which might require further work. A rough sketch[1] of the Cut-Off is included to show location of points mentioned.

F. C. Boggs,
Major, Corps of Engineers.

Fourth indorsement.

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., June 16, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. Forwarded.

2. In view of the district officer's statements in paragraphs 2 and 3 of third indorsement, there seems to be no objection to eliminating that part of the upper Chipola River above Look and Tremble Shoals from the project.

3. The estimates for maintenance, submitted in paragraph 7 of third indorsement, appear to be fair ones.

J. C. Sanford,
Colonel, Corps of Engineers, Division Engineer.

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[1] Not printed.

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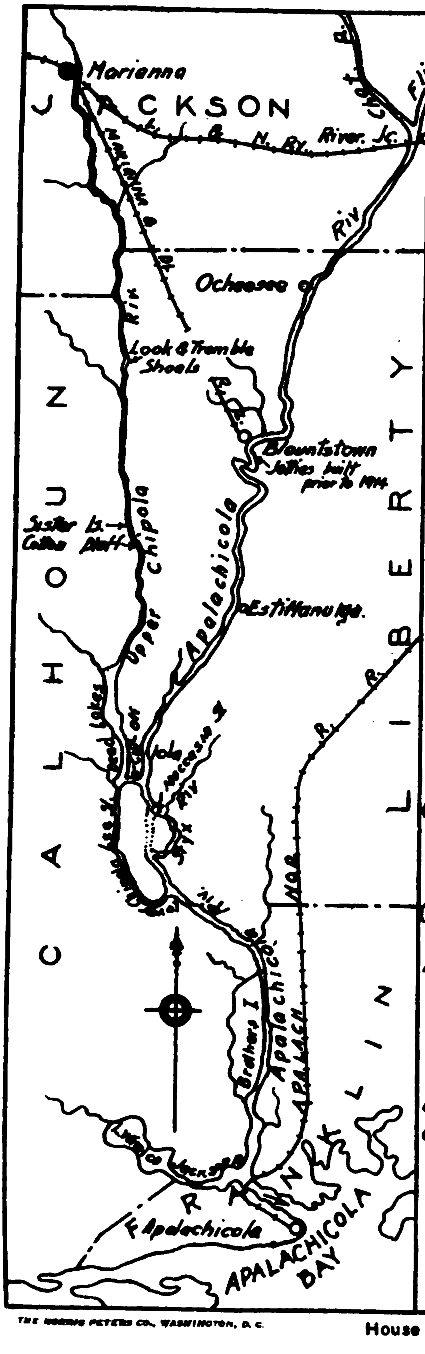
WAR DEPARTMENT CORPS OF ENGINEERS, U.S.A.



APALACHICOLA RIVER FLA. Including the CUT-OFF and lower CHIPOLA RIVER FLA and the upper CHIPOLA RIVER from MARIANNA to its mouth.

MILES

10 5 0 10

PROJECTS:

(1) Apalachicola River 100 ft. wide 6 ft deep including channel 60 ft. wide, 5 ft. deep through the Cut-Off Lee Slough and Lower Chipola River

(2) Upper Chipola R. 60 ft. wide, 3 ft. deep from Marianna to foot of Dead Lakes.

PROGRESS:
(1) About 97% Completed

(2) About 70% Completed
Dredging and Snagging

AVAILABLE DEPTHS:
(1) 4 feet, (2) 2 feet.

AMOUNT EXPENDED:
To June 30, 1915 $179,578.58

COMMERCE:
Cal. Year 1914 $13,306,745

U.S.E.O. Montgomery, Ala.
October 4, 1915.
To accompany report of this date
Earl I. Brown,
Major, Corps of Engrs., U.S.A.

THE NORRIS PETERS CO., WASHINGTON, D. C.

House Doc. No. 1725 ; 64th Cong., 2d Sess.

64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1729.

GRAYS HARBOR BAR, WASH.

LETTER

FROM

THE SECRETARY OF WAR.

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND PLAN AND ESTIMATE OF COST OF IMPROVEMENT OF GRAYS HARBOR BAR, WASH.

DECEMBER 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

WAR DEPARTMENT,
Washington, December 12, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated October 23, 1916, together with copies of reports from Maj. (now Lieut. Col.) J. B. Cavanaugh, Corps of Engineers, dated December 24, 1913, and February 14, 1914, with maps, on a preliminary examination and plan and estimate of cost of improvement, respectively, of Grays Harbor Bar, Wash., made by him in compliance with the provisions of the river and harbor act approved March 4, 1913; also copy of a report dated November 6, 1914, made by a special board of Engineer officers appointed to consider this subject.

Very respectfully,

WM. M. INGRAHAM,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, October 23, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and plan and estimate of cost of improvement of Grays Harbor Bar, Wash.

1. There are submitted herewith for transmission to Congress reports dated December 24, 1913, and February 14, 1914, with maps,

by Maj. (now Lieut. Col.) J. B. Cavanaugh, Corps of Engineers, on preliminary examination and plan and estimate of cost of improvement, respectively, authorized by the river and harbor act approved March 4, 1913, of Grays Harbor Bar, Wash., together with a report, dated November 6, 1914, by a special board of engineer officers appointed to consider this subject.

2. Grays Harbor has been under improvement since 1896, when a project was adopted providing for a south jetty with a view to securing a depth of 24 feet on the bar. This jetty was built to a length of 13,734 feet. The project was extended by the act of March 2, 1907, to include a north jetty, which has since been built to a length of 17,000 feet. These works have not resulted in securing and maintaining a channel of project dimensions, and the actual navigable depth has varied from about 12 feet to 26 feet. With a view to increasing the depth and fixing the channel in position the district officer proposes an extension of the north jetty for a distance of 5,500 feet at an estimated cost of $1,775,000. He believes that such further improvement is worthy of being undertaken by the United States, provided the port commission will repair the trestle of the north jetty and construct proper unloading facilities at Aberdeen. The division engineer concurs in the views expressed by the district officer. The special board appointed for the purpose of making a further investigation of conditions at this harbor believes that neither an extension of the south jetty nor of the north jetty would result in commensurate benefits, and that to secure and maintain the project channel both dredging and jetties will be required. It recommends the immediate restoration of the north jetty at an estimated cost of $560,000; the restoration of the south jetty at an estimated cost of $870,000; and the purchase or construction of a suitable dredge for work on the bar at an estimated cost of $450,000 and its operation at an annual estimated cost of $82,500.

3. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated August 8, 1916. During the period of nearly two years which has elapsed since the report of the special board was submitted the enrockment of the north jetty has been raised to or above the plane of ordinary high water for its entire length at a cost of about $580,000. Recent surveys have indicated a much improved condition of the channel, and it appears probable that with the aid of the recently repaired north jetty dredging alone may be sufficient to maintain the channel for many years, if not indefinitely. The board therefore believes that it is advisable to provide an efficient dredge and give it a thorough trial for a number of years before making further large expenditures on the jetties. Under present conditions in the shipbuilding industry, however, the board is of opinion that the estimated cost of the dredge should be increased to $700,000.

4. After due consideration of the above-mentioned reports I concur in the views of the Board of Engineers for Rivers and Harbors, and therefore report that it is deemed advisable to modify the existing project for improvement of Grays Harbor Bar, Wash., so as to provide for the construction or purchase of a seagoing dredge for use on the bar at an estimated cost of $700,000 and a subsequent annual

cost of $85,000 for operation. The full amount of the first cost and a sum sufficient for one year's operation, a total of $785,000, should be made available in one appropriation.

W. M. BLACK,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON PLAN AND ESTIMATE OF COST OF IMPROVEMENT.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
August 8, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following is submitted in review of the district officer's reports of preliminary examination and survey of Grays Harbor Bar, Wash., authorized by the act of March 4, 1913, and of the report of a special board convened for the purpose of considering this same subject.

2. Grays Harbor has been under improvement since 1896, when a project was adopted providing for a single south jetty with a view to securing a depth of 24 feet on the bar. This jetty was built to a length of 13,734 feet, instead of 18,200 feet, as originally projected. The project was modified by the act of March 2, 1907, to include a north jetty which has since been built to a length of 17,000 feet. These works have not resulted in securing a channel of the project dimensions. On account of shifting and division of the channel the actual navigable depth has varied from about 12 feet to 26 feet. The amount expended to June 30, 1915, as given in the report of the Chief of Engineers, is approximately $2,760,000.

3. The water-borne commerce, consisting almost entirely of lumber, increased from about 260,000 tons in 1900 to 757,000 tons in 1912. It is reported that there is naturally tributary to this harbor 94,000,000,000 feet of merchantable timber. In addition to the timber transported by water, about 1,000,000 tons were shipped by rail during the calendar year 1913. It is claimed that better channel conditions will result in larger cargoes and a consequent material lowering of shipping rates.

4. The district officer presents a plan for increasing the depth and fixing the channel by an extension of the north jetty 5,500 feet. The estimated cost of this work is $1,775,000. At the time of the submission of the district officer's report of survey, February 14, 1914, the port commission of Grays Harbor offered to cooperate in the further improvement proposed by furnishing the necessary funds to construct a suitable wharf for the transfer of stone from rail to water and to repair and maintain for one season the jetty trestle, which was then in bad condition and rapidly being destroyed, provided the extension and repair of the jetty were undertaken in the near future. The special board states that cooperation is now offered to the extent of constructing the wharf, in addition to the work necessary to provide needed facilities in the inner harbor, including terminals, on which it is expected to expend $750,000. The district officer expresses

the opinion, in which the division engineer concurs, that the locality is worthy of further improvement to the extent outlined above.

5. The special board has given careful study to this subject, and its report is in considerable detail. It considered further improvement by extending one or both jetties, by raising the existing jetties, and by dredging. It believes that neither an extension of the south jetty nor of the north jetty 5,500 feet, at a cost of $1,775,000, as proposed by the district officer, would result in commensurate benefits; that dredging in addition to the action of the jetties will be necessary to maintain the channel; that the raising of the jetties would secure such additional scour that with the assistance of a dredge the channel contemplated by the project would be obtained.

6. The special board estimates the cost of the restoration of the jetties at $1,430,000, the cost of constructing a dredge at $450,000, and the annual cost of operating the dredge at $82,500. It believes that the present and prospective commercial conditions and the probability of obtaining a satisfactory channel as the result of the above work are sufficient to justify the United States in undertaking the project. It therefore recommends:

(*a*) The immediate restoration of the north jetty at an estimated cost of	$560,000
(*b*) The restoration of the south jetty at an estimated cost of	870,000
(*c*) The purchase or construction of a suitable dredge at an estimated cost	450,000

And its operation at an annual estimated cost of $82,500, in all $1,880,000 for first construction and $82,500 for annual maintenance. Under present conditions in the shipbuilding industry the board is of opinion that the estimated cost of the dredge should be increased to $700,000.

7. The information before the Board of Engineers for Rivers and Harbors at the time of the submission of the report of the special board indicated a recent marked improvement in the condition of the entrance channel, and it was deemed advisable to note further developments in connection with contemplated repairs to the north jetty and dredging on the bar before making its final report.

8. During the past two years, the enrockment of the north jetty has been raised to or above the plane of ordinary high water for its entire length, at a cost of about $580,000, and in December, 1915, and January, 1916, a channel 600 to 700 feet wide and 25 feet deep at mean lower low water was dredged through the bar by the United States dredge *Michie*, at a cost of about $14,000. The survey of June, 1916, shows a material improvement in the channel on the bar and between the jetties. The district officer states in his annual report for 1916 that at the close of the fiscal year there was a channel across the bar in a favorable location not less than 500 feet wide and of project depth of 24 feet at mean lower low water. The total expenditures to June 30, 1916, amounted to $3,226,983.26, of which $617,778.09 was for maintenance.

9. In a supplemental report, the district officer expresses the opinion that as the north jetty is lowered by settlement and wave action the channel will tend to deteriorate and that to maintain the project depth will require the assistance of the dredge recommended by the special board and perhaps eventually further work on one or

both jetties, but the necessity for additional work on the jetties is not anticipated for many years, if an efficient dredge is provided.

10. It appears from the information now available that dredging will be required to maintain a channel of project depth even if the jetties are built up to full height and extended. It also appears that with the aid of the recently repaired north jetty, dredging alone may be sufficient to maintain the channel for many years, if not indefinitely. It is therefore believed to be the part of wisdom to provide an efficient dredge and give it a thorough trial for a number of years before making further large expenditures on the jetties. In the opinion of the board, the commercial interests involved are sufficient to justify the required expenditure. It therefore recommends that the project be modified so as to include the construction or purchase of a seagoing dredge at an estimated first cost of $700,000 and a subsequent annual cost of $85,000 for operation. The full amount of the first cost and a sum sufficient for one year's operation, a total of $785,000, should be made available in one appropriation.

11. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects which could be coordinated with the project proposed in such manner as to render a more radical improvement advisable in the interests of commerce and navigation at this time.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF GRAYS HARBOR BAR, WASH.

UNITED STATES ENGINEER OFFICE,
Seattle, Wash., December 24, 1913.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Grays Harbor Bar, Wash.

1. In compliance with section 2 of the act of Congress approved March 4, 1913, I have the honor to submit the following report on a preliminary examination of Grays Harbor Bar, Wash.

2. Previous examinations and surveys of Grays Harbor and bar entrance are found in Senate Document No. 112, Forty-seventh Congress, first session; House Document No. 576, Fifty-eighth Congress, second session; and House (Rivers and Harbors Committee) Document No. 29, Sixty-first Congress, second session; and Annual Report, Chief of Engineers, 1895, pages 3517 to 3533, inclusive.

3. *Description.*—Grays Harbor is a large bay in the southwestern part of the State of Washington connecting with the Pacific Ocean about 48 miles north of the mouth of the Columbia River. It has a total length from east to west of 17 miles and its greatest breadth north and south is 14 miles.

A large part of the bay is occupied by tide flats, bare at low water, the area covered by water at low tide being about 30 square miles or less than one-third of the total area at high tide.

A short distance within the harbor there is an extensive and well protected anchorage for deep-draft vessels.

The harbor entrance is between two low sandy peninsulas, which are about 12,500 feet apart, measured between high-tide lines. Through this entrance a single broad waterway extends for more than 2 miles out to sea, gradually diminishing in depth from over 100 feet to less than 30 feet. At the outer end of this deep waterway lies a bar convex to the sea and extending each way to the sand spits on the sides of the harbor throat.

Prior to improvement there were several shifting channels across the bar having depths of about 12 or 13 feet, but no good permanent channel existed. The general width of the bar between the inner and outer 18-foot curves was about one-half mile.

4. Grays Harbor Bar has been under improvement since 1898, when work was started under a project which called for a depth of 24 feet at mean lower low water to be secured by the construction of a single jetty on the south side 18,200 feet long, the estimated cost being $1,000,000.

The construction work continued from March 8, 1898, until October, 1899, without cessation, and during this time the profile along the trace of the jetty remained practically the same as that indicated upon the plan when the project was formulated. During the succeeding winter, however, several channels were scoured out across the south spit and its crest generally lowered. When work was resumed in the spring of 1900 depths as great as 33 feet were found instead of a spit bare at low tide. This scouring in advance of the jetty continued to the end of the work and with the funds appropriated limited the south jetty to a length of 13,750 feet instead of 18,200 feet as planned, while the crest of the enrockment was carried only to high tide (+8) instead of to the line of extreme high tide. The work was completed in the fall of 1902, practically five working seasons being required for its construction.

About the time work on the south jetty was suspended for lack of funds there was a low-tide channel across the bar for a brief period, with a depth of 22 feet, but the north spit soon began to wear away and the bar channel first widened and then separated into several channels radiating from the harbor throat. Conditions became gradually worse and culminated in 1906, when there was a low-water depth on the bar of only 12 feet.

The unfavorable conditions in 1906 led to an appropriation of $600,000 for a north side jetty extending in a southwesterly direction from Point Brown for a distance of about 9,000 feet, measured from the high-water line. This project called for a mid-tide jetty, the object of which was to arrest the tendency of the harbor throat to move northward, and it was considered better to build at first a structure incomplete in both length and height, leaving it to be determined by the results of this work what further steps might be required later.

Work on the north side jetty was started in 1907, continued in 1908, 1909, and completed in 1910, the last rock being placed in November, 1910. As the trestle and enrockment were practically complete in 1909, extending the jetty to about 10,000 feet beyond the high-water line, and it was evident that extension of this jetty would be necessary to secure a reliable channel and fix it in position, the extension of the north jetty by 7,000 feet to a point nearly opposite the end of the south jetty was authorized in 1910, $75,000 being appropriated toward the work. In 1911 an additional appropriation was made and completion of the extension was authorized under the continuing contract system. Work on this extension was commenced in 1911, and completed during 1913, the jetty having been brought to mid-tide and above for a distance of about 17,000 feet beyond the high-water line.

5. The construction of the north jetty and extension has materially improved the channel across the bar, but the tendency to develop a second channel to the northward has not been entirely corrected. The map of the last bar survey indicates a shifting of the buoyed channel to the north and a crowding of the north channel to the south, accompanied by a general deepening of the bar in front of the jetties which may result in the formation of a single channel but to the north of the best position for the entrance. There is also some pushing of the bar to seaward, particularly to the north of the entrance, accompanied by a narrowing of the base and tailing spit of the south jetty. Information from mariners using the bar is to the effect that the south channel has shifted over 1,900 feet to the northward since the last survey was made.

6. Seventeen sheets,[1] covering all known surveys of this bar, are submitted herewith to permit a comparative study of bar conditions at different times. The earlier surveys are doubtless not entirely correct, and the series is lacking in completeness, as it fails to show the important changes between the summer of 1906 and 1909. In fact, no survey, with the possible exception of that of 1881, indicates the bar with the channel in the desired position to the southward. As the sudden breaks which throw the channel to the south always occur during the winter storms, surveys immediately thereafter are practically impossible, and by the following summer the channel has shoaled and its cyclic movement to the north is well under way.

In the fall of 1906, shortly after the survey shown on sheet 13 was made, the channel broke out to the southward, and for a short time depths exceeding 24 feet were available.

7. The history of this bar shows the usual cycle of changes, due to a resultant northward littoral current such as that which is clearly established by observations at Grays Harbor. The channel is crowded slowly northward until shoaling and increased distance to deep water result in a sudden break across the bar to the southward. When these breaks occur the resulting channel has occupied the most favorable position with reference to storms and the available depths have been the greatest, reaching as much as 26 feet at mean lower low water. Present indications are that such a break across the tailing spit of the south jetty may be expected in the near future.

8. While the extension of the north jetty has restricted the flow to the north and modified the regular cycle of changes of the channel by reducing the arc through which it shifts, the outer end of this jetty has not yet been extended to a point opposite the end of the south jetty with reference to the best position of the channel across

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[1] Only nine printed.

the bar. It is believed that the north jetty should be extended about 5,000 feet farther to properly deflect the outflowing currents and force them to cross the bar in the proper direction. Such an extension, by cutting off the flow to the northward, may force the channel southward by gradual erosion, even if a sudden break to the southward does not occur. With the channel once forced into the proper position, the proposed extension of the north jetty should hold it there.

All recent surveys show a marked deflection of the ebb current to the northward from the groin on the north side of the south jetty, and this deflection under present conditions tends to maintain the channel past the end of the north jetty, a tendency which the extension of the north jetty should correct.

9. The commerce of Grays Harbor actually crossing the bar, which consists principally of lumber outward bound, has been for the last 15 years as follows:

Calendar year.	Short tons.	Value.	Calendar year.	Short tons.	Value.
1898	168,468	$1,252,089	1906	614,854	$7,735,954
1899	265,918	1,979,998	1907	747.725	8,862.687
1900	259,692	2,077,037	1908	827.154	7,421,311
1901	299,607	1,877,800	1909[1]	527.220	4,802,333
1902	527.047	3,601,163	1910	671,336	5,016,752
1903	458,268	4,073,333	1911	710,840	6,092,836
1904	495,495	4.200,784	1912	757.636	6,389,186
1905	579,759	5,562,166			

[1] Differs from amounts published in report of 1910 by omission of log traffic that does not pass over the bar.

This table indicates a steady growth, varying with the condition of the bar and the fluctuations in the lumber market. If a suitable channel having a depth of 24 feet could be secured and maintained, permitting the use of the larger type of vessels ordinarily employed in the export trade, rapid and material increase in this commerce could reasonably be expected. Even under present conditions there is an increasing tendency to employ vessels of greater draft, the maximum during the present season being 21.6 feet and the average 17 feet. These attempts to utilize to the fullest extent depths now available have led to frequent groundings of loaded vessels on the bar. The history of the present season shows an increase over previous years in the matter of inconvenience and loss to commerce due to insufficient depth, numerous vessels having been bar bound this fall a total of nearly 400 days.

10. As there is tributary to Grays Harbor a sufficient amount of the finest timber to support a large commerce for 50 years or more, and the handicap of insufficient depth is becoming more serious each year, the project depth of 24 feet should be provided, if it can be secured by any reasonable expenditure. The differential in favor of the deeper ports of Puget Sound under present conditions is not less than 75 cents per 1,000 feet on lumber, and a reliable 24-foot bar channel should reduce this differential at least one-third, which would mean an annual increase in the value of the present shipment of lumber, or a saving to the consumer of over $125,000 per year.

11. In my opinion, therefore, Grays Harbor Bar is worthy of further improvement by the United States, and it is recommended

that I be authorized to submit an estimate of the cost of extending the north jetty for a farther distance of not less than 5,000 feet.

12. With reference to the special subjects to be investigated, the following is submitted:

As the great bulk of the commerce is lumber, and this is loaded directly at the mills where manufactured, the question of terminals has not the usual importance on Grays Harbor. The cities of Aberdeen and Hoquiam each maintain public wharves adequate for present needs to accommodate commerce other than that pertaining to the lumber industry.

No modern methods of quick transfer of freight are used, the ordinary means of handling lumber from mills and yards to ships being employed. The water terminals are open to all water carriers, subject to wharfage charges limited by State laws. Terminals are all private or city property, but ample frontage for the construction of other terminals exists.

No physical connection exists between water terminals and the railroads except by ordinary sidings. The Northern Pacific Railroad, the Chicago, Milwaukee & Puget Sound Railroad, and the Oregon-Washington Railroad & Navigation Co. all connect with Aberdeen and Hoquiam. So far as known, no contracts exist for the interchange of traffic between the water carriers and these railways.

No questions of water power or flood protection arise in connection with the improvement proposed.

J. B. Cavanaugh,
Major, Corps of Engineers.

[First indorsement.]

U. S. Engineer Office, Northern Pacific Division,
San Francisco, Cal., December 29, 1913.

To the Chief of Engineers, United States Army:

1. Concurring in the views expressed by the district engineer officer.

Thos. H. Rees,
Lieutenant Colonel, Corps of Engineers, Division Engineer.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
January 13, 1914.

To the Chief of Engineers, United States Army:

For reasons stated herein, the board concurs with the district officer and the division engineer in recommending a survey in order to determine the extent and advisability of the improvement. It is also recommended that the district officer be instructed to report upon the extent, if any, to which local cooperation can be secured.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member Present.

PLAN AND ESTIMATE OF COST OF IMPROVEMENT OF GRAYS HARBOR BAR, WASH.

UNITED STATES ENGINEER OFFICE,
Seattle, Wash., February 14, 1914.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Plan and estimate of cost for extension of north jetty at Grays Harbor, Wash.

1. In compliance with instructions contained in letter from the officer of the Chief of Engineers, dated January 17, 1914, the following plan and estimate of cost for the extension of the north jetty at Grays Harbor are submitted.

2. It is proposed to extend the north jetty approximately 5,500 feet, in a southwesterly direction, practically in prolongation of the outer portion recently completed, with a view to holding the channel across the bar in the position which has usually afforded the greatest depth of water and is the best for ease of access. The plan contemplates the construction of a jetty with crest at high tide or approximately 8 feet above mean lower low water, to be built by depositing large rubble stone from a trestle, in accordance with the methods heretofore employed on the north jetty. Based upon experience with the present jetty, and upon the large amount of gravel found upon the line of the proposed extension, it is assumed that scour will not be excessive and that the bottom of the jetty will not subside to a greater average depth than 30 feet below mean lower low water, also that the side slopes will not be flatter than 1 on 1¼ to 1 on 1½, and the final elevation of the crest will not be reduced by wave action much below mid-tide level, except at the outer end.

The width of the crest will be increased as required for the protection of the trestle, and it is anticipated that this width will be not less than 25 feet for the outer portion. To minimize the effect of storms it is proposed to cover the top and upper slopes of the jetty with large blocks of granite or other heavy stone, limiting the use of the lighter sandstone to the interior of the jetty, since it is believed that the necessary heavy stone can be obtained near Grays Harbor at a reasonable price.

From two to four short groins will probably be required on the south side of the jetty for its protection against scour and to properly direct the current across the bar, and their construction is provided for in the estimate.

3. The estimate in detail is as follows:

Extension of trestle and track 5,500 feet	$55,000
Additions to plant and extension of wharf	35,000
700,000 tons of stone at $2 per ton	1,400,000
	1,490,000
Superintendence and contingencies, including maintenance of existing trestle, approximately 20 per cent	285,000
Total	1,775,000

4. In accordance with your instructions, the matter of cooperation by local interests in the proposed extension of the north jetty was taken up with the port commission of Grays Harbor at a meeting in

Hoquiam on February 8, 1914, at which representatives of commercial bodies of Hoquiam and Aberdeen were also present. As a result of this conference, proposition has been submitted by the port commission (inclosed herewith) to furnish the necessary funds to repair and maintain the jetty trestle this season, and to construct a suitable wharf for the transfer of stone from rail to water should the extension of the jetty be provided for by Congress. While the amount of money actually to be applied to work on the jetty under this proposition is relatively small, the assistance to the project would be very great if the further extension of the north jetty is to be undertaken in the near future. Unless the trestle is extensively repaired this season, it will largely disappear next winter, and its ultimate construction would involve large expenditure and loss of time, possible as much as three years. Prompt repair this season is rendered particularly desirable and necessary by the fact that the storms this winter have made a bad break in the trestle about 10,000 feet from the shore line, completely isolating the outer and newer portion of the trestle. Extensive repair of the inner portion will be necessary to reach the valuable outer portion, in order to put it in shape before the beginning of the next stormy season. If there is any reasonable prospect that the extension to the north jetty as herein recommended will be authorized by Congress, the port commission stands ready to make immediate provision for the repairs necessary for the proper maintenance of the existing trestle, pending such favorable action by Congress.

In this connection it may be added that local interests, in practical cooperation with the improvement of Grays Harbor, have created the port district of Grays Harbor, and elected a port commission which, under State laws, is authorized to assess a regular tax levy for port purposes and to issue bonds up to 3 per cent of the assessed valuation of the port district, after the consent of the district has been given at any regular election. At a recent election, a comprehensive scheme of port development prepared by Mr. Virgil G. Bogue was adopted, and as a logical extension of this scheme is an extensive improvement of channels in Chehalis River and the inner harbor, it was my opinion that the improvement and maintenance of these channels, rather than work upon the jetties, was the proper field for local cooperation. However, in view of the present situation and the recognized importance of providing funds immediately for the maintenance of the trestle so the prosecution of the work may be continuous if the extension of the north jetty is to be undertaken in the near future, the port commission has offered to devote a large part of its present resources to the immediate repair of the trestle, and after an extension of the project has been authorized also to construct proper unloading facilities at Aberdeen in line with the adopted scheme of port development, so that the stone for the jetty may be handled rapidly and economically.

5. In my opinion, the further improvement of Grays Harbor bar by the extension of the north jetty approximately 5,500 feet, conditioned on local cooperation as offered by the port commission, is worthy of being undertaken by the United States. In view of the probable large loss of time and money resulting from any material suspension of operations, it is recommended that provision for the

work be made at the present session of Congress, preferably in the form of an appropriation of not less than $150,000, and a continuing contract authorization for the remainder of the estimate. To minimize work upon the trestle and secure results as soon as practicable. the extension of the jetty should be completed in not more than three working seasons.

J. B. CAVANAUGH,
Major, Corps of Engineers.

[First indorsement.]

U. S. ENGINEER OFFICE,
NORTHERN PACIFIC DIVISION,
San Francisco, Cal., February 18, 1914.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Concurring in the views expressed by the district engineer officer.

THOS. H. REES,
Lieut. Col., Corps of Engineers, U. S. Army.

[For report of the Board of Engineers for Rivers and Harbors on plan and estimate of cost of improvement, see p. 3.]

RESOLUTION NO. 13, BY THE COMMISSIONERS OF PORT OF GRAYS HARBOR, MAKING APPROPRIATION OF $30,000 FOR MAINTENANCE OF THE NORTH JETTY, AND APPROPRIATION OF $15,000 FOR PROVIDING SHIPPING TERMINALS AT GRAYS HARBOR TERMINAL.

Whereas owing to the lack of Federal appropriation there is a possibility of loss of time of from six months to three years in further progress toward the completion of the North Jetty, and

Whereas such loss of time due to interruption of maintenance would entail an actual money loss in trestle and temporary work running into the hundreds of thousands of dollars, and

Whereas it is to the interest of the port of Grays Harbor and the people of the port district of Grays Harbor that the extension of the North Jetty should be attended with the least possible delay, and

Whereas any further appropriations by the Federal Government can not possibly be available before from six to eight months from this date, and an interruption of work would therefore ensue: Now, therefore, be it

Resolved, That the port of Grays Harbor hereby appropriates from such funds as are available $30,000, or so much thereof as may be necessary, for the maintenance and repair of the trestle work of the North Jetty during the coming summer or until such time as Federal funds become available, such money to be expended under the direction of the Engineers Office, United States War Department.

Whereas it is necessary that more economic and extensive terminals for the handling of rock from cars to barges for use on the jetty be provided, and

Whereas such developments could be advantageously made on the property of the port of Grays Harbor at the Grays Harbor Terminal and is in line with the general plans of the port of Grays Harbor: Now, therefore, be it

Resolved, That there be appropriated from the funds of the port of Grays Harbor, applicable for such purposes, the sum of $15,000, or so much thereof as may be necessary, for the construction of such a terminal, including rail connections for the dredging of slips as necessary. This appropriation to be contingent upon the passage at this session of Congress of an appropriation providing for the extension of the North Jetty as recommended by the local United States Engineers office.

This is to certify that the foregoing resolution was introduced at the regular meeting of the commissioners of the port of Grays Harbor, held on the 9th day of February, 1914, by Commissioner Patterson. Upon motion, was read the second time and placed on final passage on the 9th day of February, 1914. Upon the final passage Commissioners Lamb and Patterson and McNeill voting "Yes" thereon. Receiving, therefore, a majority of vote of said board, was passed.

FRANK H. LAMB, *President.*

REPORT OF SPECIAL BOARD OF ENGINEER OFFICERS ON IMPROVEMENT OF GRAYS HARBOR, WASH.

SEATTLE, WASH., *November 6, 1914.*

From: Special Board of Engineer Officers.
To: The Chief of Engineers, United States Army.
Subject: Improvement of Grays Harbor, Wash.

1. This is the report on the above subject by the board appointed by the following order:

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, June 23, 1914.

SPECIAL ORDERS,
No. 11.

By authority of the Secretary of War a board of officers of the Corps of Engineers, to consist of Col. Edward Burr, Lieut. Col. Thomas H. Rees, Lieut. Col. Charles L. Potter, Lieut. Col. Charles H. McKinstry, Maj. James B. Cavanaugh, Capt. Theodore H. Dillon, recorder, is appointed to assemble at Seattle, Wash., upon the call of the senior member, for the purpose of considering and reporting upon the improvement of Grays Harbor Bar, Wash., under authority of the river and harbor act of March 4, 1913.

The board is authorized to visit such points as it deems necessary for the proper performance of its duties.

Upon the completion of the duties assigned to them the members of the board will return to their proper stations.

The travel directed is necessary in the military service (8225–C. of E.).

By command of the Chief of Engineers:

EDW. BURR,
Colonel, Corps of Engineers.

2. By Special Orders No. 18, War Department, October 14, 1914, Maj. Jay J. Morrow, Corps of Engineers, was appointed a member of the board, vice Col. Edward Burr, relieved.

3. The board was directed by the Chief of Engineers to consider and report upon the matters mentioned in the following letter of the Board of Engineers for Rivers and Harbors:

From: The senior member, Board of Engineers for Rivers and Harbors.
To: The Chief of Engineers, United States Army, Washington, D. C.
Subject: Recommending appointment of special board for study and report on project for improving Grays Harbor Bar, Wash.

1. The board has considered the reports of the district officer in this case, and gave a hearing in reference thereto on May 5, 1914, a record of which is transmitted herewith, together with the other papers. Although the expenditures on this bar have been greater than the amount originally contemplated, the board is inclined to the opinion that it may be desirable to take further steps to secure the project depth of 24 feet, if this can be done without too great cost, but it is not convinced that the work proposed by the district officer is sufficient or best adapted to produce the desired result. The project has already been twice modified with the expectation of providing the depth of 24 feet, which the original project promised but failed to give.

2. There are several additional features that seem to merit further consideration with a view to determining their advisability:

(*a*) Raising the south jetty.
(*b*) Extending the south jetty.

(*c*) Extending the north jetty beyond the point proposed by the district officer.

(*d*) Use of dredging to increase depth on bar.

(*e*) Larger cooperation by local interests.

(*f*) Worthiness of further improvement in view of probable total expenditure involved.

3. It is thought that a comprehensive study should be made of the entire situation and estimates prepared indicating the probable limit of further expenditures that may be required to secure the project depth. It is recommended that a special board be ordered to make such a study and report its conclusions.

For the board:

W. M. Black,
Colonel, Corps of Engineers,
Senior Member of the Board.

4. Upon call of the senior member, the board met at Seattle, Wash., at 10 a. m., July 14, 1914, all the members being present.

5. July 15–17, the board visited the cities of Aberdeen, Hoquiam, and Cosmopolis, inspected the lower Chehalis River, the inner harbor and the harbor entrance, and on July 16 at 3 p. m. held at Aberdeen a public hearing, notice of which had been published in the local papers. The hearing was well attended and several persons made addresses. Report of this hearing is submitted herewith. (See Appendix D.)

6. On July 17 the members of the board visited the logging camps of the Polson Logging Co., near Humptulips, about 30 miles north of Hoquiam, for the purpose of obtaining an idea of the timber resources of the district.

7. The board was in session daily from July 14 to 19, 1914, inclusive, and from November 5 to 6, 1914, inclusive.

8. In addition to the papers referred to the board by the Chief of Engineers, the board had before it all previous reports and various congressional documents referring to this improvement, all maps of surveys made since 1862, and three relief models prepared by the district officer, showing, respectively, conditions at the entrance in 1894 before improvement was undertaken and at the times of the surveys of 1913 and 1914.

I. GRAYS HARBOR BAR.

9. Grays Harbor is a large bay in the southwestern part of the State of Washington, connecting with the Pacific Ocean. It is 48 miles north of the mouth of the Columbia River and is 658 and 112 miles from San Francisco and Straits of Juan de Fuca, respectively. Its total length from east to west is 17 miles and its greatest breadth from north to south is 14 miles. The low-tide area is estimated at 30 square miles, and the high-tide area at 96 square miles. The mean range of tide is 8.4 feet and the maximum range is 14.6 feet. The maximum tidal runout was estimated by the district officer in 1895 at 24 billion cubic feet, and the mean tidal runout was estimated at 16 billion cubic feet, or 746,000 cubic feet per second.

10. The entrance is obstructed by the usual bar convex to the sea, and extending to the sand spits on each side of the harbor throat. The depths over the bar have varied from 12 to 26 feet. The general average width across the bar between 18-foot contours is ½ mile. Within the entrance are large areas affording good anchorage for deep-draft vessels.

11. The history of this bar before improvement showed the usual cyclic changes due to northward littoral currents and drift indicated by observations at Grays Harbor. The channel was crowded slowly northward until shoaling and increased distance to deep water, with narrowing of the bar on the south, resulted in a sudden breakout to the southwest.

12. The prevailing winds in summer are from the northwest. The most severe storms occur in winter. The gales usually begin blowing from the southeast, swing to the south, and then to the southwest, attain a maximum velocity while in the southwest and generally last about 36 hours.

13. The most favorable bar channel, both for ease of navigation in storms and for greatest available depth, is one having a southwesterly direction and located in the southwesterly quarter of the bar.

II. HISTORY OF IMPROVEMENT.

14. The original plan proposed for the improvement of Grays Harbor bar is contained in the report of the district officer dated March 20, 1895, and was to obtain and maintain a channel 24 feet deep at mean lower low water. It contemplated the construction of a single jetty on the south side of the entrance about 3½ miles long and rising above high-tide level. The estimated cost was $1,000,000.

15. The division engineer in reporting upon this plan expressed the opinion that a single jetty would be insufficient and that twin jetties would be required. The district officer's estimate of the cost of twin jetties was $2,363,309.

16. The river and harbor act of June 3, 1896, appropriated $1,000,000 for the single (south) jetty project. The jetty was built between March, 1898, and September, 1902. Due to scour around the end during construction only 13,734 feet of jetty, measured from the high-water line, instead of 18,200 as originally projected, could be built within the limits of the appropriation. The jetty was constructed on practically a straight line, and its outer third lies to the north of the alignment originally proposed. The enrockment was built only to high tide instead of extreme high tide. No work has been done on this jetty since 1902. The outer portion has been beaten down below mean lower low water, the remainder being at or slightly above that level.

17. During the construction of the jetty the bar channel gradually improved until in 1902 it was 22 feet deep at mean lower low water. Subsequently, coincident with the swing of the channel to the north the depth deteriorated, and by the summer of 1906 had shoaled to 12 feet.

18. In 1903–4 upon request from the River and Harbor Committee of the House of Representatives this improvement was studied and reported upon by a special board and by the Board of Engineers for Rivers and Harbors.

19. In the report of the special board dated January 28, 1904, various methods of continuing the improvement with a view to obtaining the project depth were discussed, namely, prolonging the existing jetty to the crest of the bar, building an additional jetty on the north side of the entrance, and dredging with a self-contained sea-

going bar dredge. With respect to dredging "the board was unanimous in the view that the success of dredging work on exposed bars on the Pacific coast, and the making and extending of navigable channels through such bars by this means, is still extremely doubtful, and it was decidedly of the opinion that an experiment that would take so much time and money with so little prospect of success was not to be recommended for Grays Harbor Bar at present." The board estimated at $500,000 the cost of extending the existing jetty to the length originally proposed, and was of the opinion that this extension, in connection with a short jetty and certain shore protection, on the north side at a cost of about $508,000 would secure the project depth. The board estimated at $2,334,818 the cost of building the north jetty recommended by the division engineer in 1895.

20. The Board of Engineers for Rivers and Harbors in their report of February 15, 1904, expressed the opinion that unless the project channel could be secured by dredging a permanent channel across the bar 24 feet deep at mean lower low water could be secured only by means of two jetties of the length proposed by the division engineer in 1895, and that the extension of the south jetty would cost about $650,000, and the building of the necessary north jetty about $2,500,000. The recommendation of the board was as follows:

> In view of the great cost involved in the proposed jetty project and the possibility of dredging operations now in progress on Columbia River Bar demonstrating the practicability of attaining the desired result at Grays Harbor at a much reduced cost, the board can not recommend as desirable that the United States should undertake at the present time the further improvement of Grays Harbor.

21. As already stated conditions became gradually worse until 1906 when there was a low water depth of only 12 feet. This was followed during the winter by a "break-out" to the southwest, giving a channel in the most favorable location with a depth of 26 feet at mean lower low water.

22. The unfavorable conditions in 1906 led to further consideration by the Board of Engineers for Rivers and Harbors which recommended, under date of December 28, 1906, the construction of a north jetty extending in a southwesterly direction from Point Brown for a distance of 9,000 feet, measured from the high water line. The object of this jetty, which was to be built with crest at midtide, was to resist the tendency of the harbor throat to move northward. The estimated cost was $600,000. Dredging was considered but not recommended. The board expressed the opinion that, while the construction of this first 9,000 feet of north jetty might not create a depth of 24 feet, it would materially improve existing conditions, and that the expenditure was warranted by the extent and character of the commerce at Grays Harbor.

23. This project was adopted by the river and harbor act of March 2, 1907, and the jetty, 9,000 feet in length, was built between 1907 and 1909. At the completion of the work the channel depth was 19 feet. There has never been less than 18 feet since 1906.

24. In 1910 this improvement was again the subject of investigation and report. The channel depth at this time was 19 feet as against 12 feet in 1906, but the district officer pointed out that "this gain must not be attributed solely to the north jetty, for the depth on the bar increased from 12 to 24 feet (in 1906) before the work on the

north jetty was actually undertaken and subsequently decreased to 19 feet." To obtain the project channel and hold it in position, the district officer recommended a 7,000-foot extension of the north jetty, the enrockment to have a crest width of 8 feet at mean tide, with side slopes of one on one and one-half on the south side, and one on one and one-quarter on the north side; estimated cost, $1,030,000. He stated:

> The history of this bar shows that the best depths were always had when the channel across it broke out in a southerly direction and an examination of the survey map of 1909 shows that the thinnest part of the bar is now near the end of the south jetty.
>
> It is believed that a rapid extension of the north jetty will cause the bar to break through at this point, and that the completion of the north jetty to a point opposite the end of the south jetty will be sufficient to hold the main channel in this position.

25. With respect to methods of improvement other than the recommended extension of the north jetty, the district officer reported that no further extension of the south jetty was desirable, also that six years had elapsed since the time (1904) when the Board of Engineers for Rivers and Harbors had considered the improvement of this bar by dredging, but that not enough had been accomplished by dredging on the Columbia River bar to warrant the belief that it would be successful on the Grays Harbor Bar. He stated that:

> Without jetties to hold the channel across the bar in a fixed position it is believed that any dredged cut would be obliterated in a single storm. With a fixed channel dredging may be useful in increasing the depth, but the north jetty is not yet long enough to fix the channel in position.

26. The division engineer in approving the extension of the north jetty 7,000 feet stated that the proposed jetty was of rather light cross-section and would probably require repairs and strengthening in the future, and that both jetties might need extension. The Board of Engineers for Rivers and Harbors in its report of March 1, 1910, recommended the adoption of the project of the district officer, adding that "the board invites attention to the narrow top width proposed for the jetty and the probability of its becoming greater by natural settlement during construction, involving some increased expenditure." The board recommended this project as advisable on account of "the large and growing commerce of the locality, which was of a character most economically carried in vessels of considerable draft."

27. This extension of the north jetty 7,000 feet was authorized by the act of June 25, 1910. Work was commenced in 1911, and was completed in 1913. The jetty was brought to mid-tide and above for a distance of 17,000 feet from the high-water line.

28. In compliance with instructions contained in the river and harbor act of March 4, 1913, the district officer submitted (Dec. 24, 1913), a report on a preliminary examination of Grays Harbor Bar, in which he stated:

> While the extension of the north jetty has restricted the flow to the north and modified the regular cycle of changes of the channel by reducing the arc through which it shifts, the outer end of this jetty has not been extended to a point opposite the end of the south jetty with reference to the best position of the channel across the bar. It is believed that the north jetty should be extended about 5,000 feet farther to properly deflect the outflowing currents and force them to cross the bar in proper direction. Such an extension, by

cutting off the flow northward, may force the channel southward by gradual erosion, even if a sudden break to the southward does not occur. With the channel once forced into the proper position, the proposed extension of the north jetty should hold it there.

29. In his survey report of February 14, 1914, the district officer estimated the cost of a 5,500-foot extension of the north jetty at $1,775,000. The enrockment was to be piled to 8 feet above datum with a crest width increasing from 8 feet at the inner to 25 feet at the outer end. The side slopes were taken at one on one and one-quarter to one on one and one-half, and to allow for scour the enrockment was estimated to be based at elevation 30 feet below mean lower low water. In direction the extension was to be in prolongation of the outer portion of the present north jetty. He expressed the opinion that "the further improvement of Grays Harbor Bar by the extension of the north jetty approximately 5,500 feet, conditioned on local cooperation as offered by the port commission, is worthy of being undertaken by the United States."

30. The district officer, in letter to the Chief of Engineers, dated February 18, 1914, stated that the proper solution of the problem would require the extension of both jetties, but that under present conditions the extension of the north jetty was more important than the extension of the south jetty.

31. In a letter to the Chief of Engineers dated March 24, 1914, the Board of Engineers for Rivers and Harbors reviewed the preliminary examination and survey reports of the district officer and stated that it "was unable to concur in the district officer's recommendation for the improvement of Gray's Harbor." The grounds for this finding were as follows:

(*a*) The cost of the work, taken in connection with expenditures already made, is considered excessive when compared with the commerce of the port.

(*b*) The recent extension of the north jetty may result in more stable channel conditions than have existed in the past.

(*c*) It is by no means certain that the further extension proposed would insure the project depth; on the contrary, it is probable that further work, involving large expenditures, would be required.

(*d*) Experience at this harbor entrance appears to indicate that it is not economically advisable at the present time to attempt to secure greater depths than can be obtained with the existing jetties.

32. Further statements and arguments bearing upon the necessity for the improvement were invited from interested parties. After a hearing, at which a committee from Grays Harbor presented, among other data, the statement herewith, marked "C," the Board of Engineers for Rivers and Harbors recommended under date of May 19, 1914 (see par. 3 above), that a special board be appointed to make the investigation which is the subject of the present report.

III. CONDITIONS, NOVEMBER, 1914.

33. The south-jetty enrockment has been beaten down by the waves until the crest of the outer end is below low water. With the exception of the last 1,000 feet or so, the crest of the jetty is pretty generally at or above mean lower low water. The jetty has suffered no considerable reduction in height during the past few years. The trestle and receiving wharf have entirely disappeared. No work has been done on the south jetty since 1902.

34. On November 1, 1914, repairs to the north jetty had been carried to bent 650. There are 135 piles to be replaced to bent 1087. Beyond this point is a complete break in the trestle, leaving a considerable portion of the newer trestle isolated. The detached part of the trestle is apparently in good condition (40 piles gone in October). No settlement of the enrockment has taken place as far out as bent 1020, a distance of 12,500 feet. The next 1,000 feet shows settlement of about 2 feet. Beyond this for a distance of another 1,000 feet there has been a settlement of 5 or 6 feet, with the crest about a foot below mean lower low water. The last 2,500 feet of the jetty is about at low water. A shoal has formed at the receiving wharf, so that an extension of the wharf will be required before extensive new work can be undertaken.

35. The controlling depth of the buoyed channel, which has not been less than 18 feet since 1906, was 19 feet at the time of the June, 1914, survey. A comparison of the 1913 and the 1914 surveys shows that of the two bar channels the buoyed channel is almost unchanged in depth and position, while the northerly channel has swung farther to the north and has increased considerably in depth and width. The latter channel has a controlling depth of 24 feet, and, while practicable during good weather in the summer, it is not in a favorable location for use in the winter. It is not buoyed and has not been used up to November, 1914.

36. The construction of the jetties, while not preventing the shifting of the channel or its tendency to divide, has confined it to a shorter arc of the bar and has materially improved channel depths.

IV. COMMERCIAL CONDITIONS—BENEFITS TO FOLLOW FURTHER IMPROVEMENTS.

37. From a commercial standpoint Grays Harbor is the most important harbor on the Pacific between San Francisco and Puget Sound, with the exception of the Columbia River. The principal cities are Aberdeen, Hoquiam, Cosmopolis, and Montesano. The aggregate population of these cities has increased from 7,000 in 1894 to 54,000 in 1914.

38. Grays Harbor is the natural shipping port of its own drainage area and of the western portion of the Olympic Peninsula, comprising a total area of 4,600 square miles.

39. The following table of commercial statistics is taken from data furnished by the district office:

Calendar year.	Short tons.	Value.	Calendar year.	Short tons.	Value.
1898	168,468	$1,252,089	1906	614,854	$7,735,954
1899	265,918	1,979,998	1907	747,725	8,862,687
1900	259,692	2,077,037	1908	827,154	7,421,311
1901	299,607	1,877,800	1909[1]	527,220	4,802,333
1902	527,047	3,601,163	1910	671,336	6,016,752
1903	458,268	4,073,333	1911	710,840	6,092,836
1904	495,495	4,200,784	1912	757,635	6,389,186
1905	579,759	5,552,166			

[1] Differs from amounts published in report of 1910 by omission of log traffic that does not pass over the bar.

Shipments and imports by rail not included.

40. The cities of Aberdeen and Hoquiam maintain public docks adequate for present needs to accommodate commerce other than that of the lumber industry. Wharfage charges are regulated by State law. Ample frontage exists for the construction of additional terminals. Practically all the lumber mills are situated on deep water and maintain their own wharves, where they load direct from mill to vessel. Three transcontinental rail lines connect with Grays Harbor, through Portland, Olympia, Seattle, and Tacoma. Ordinary sidings connect rail and water terminals. So far as known no contracts exist for interchange of traffic between rail and water carriers.

41. The principal industry is the manufacture of lumber. At the present time there are 26 mills, having a total daily capacity of between 2,000,000 and 3,000,000 feet, board measure. There is also a considerable export of laths, shingles, doors, etc.; whale oil, fertilizer, canned salmon, and clams.

42. The following information relating to present and prospective commercial conditions and to the disadvantages incident to the fact that the project depth is not available at this port are taken from the statement furnished the Board of Engineers for Rivers and Harbors by the committee representing the commercial bodies of Grays Harbor. (See Appendix C to this report.) There is naturally tributary to Grays Harbor 94 billion feet, board measure, of merchantable timber, of which about 28 billion feet, board measure, is on United States Government Reservations. This includes only lumber of No. 2 or higher grades. In addition it is estimated that there is about 25 billion feet, board measure, of grades Nos. 3 and 4, which is not marketable under present conditions, but which may become so on reduction of freight rates. The valleys and logged-off lands are naturally fertile and the production of dairy and farm products is increasing. Several companies are engaged in drilling for oil, and favorable indications have been encountered. In 1894, 255 vessels crossed the bar outward bound. In 1908, 834 vessels crossed the bar, but since that time the number has been decreasing. In 1913, 542 vessels crossed the bar outward bound. There has, however, been a steady increase in tonnage, due to the use of larger vessels.

The following statistics relate to the calendar year 1913:

EXPORTS.

[On permissible draft, 19 feet 6 inches.]

Shipments.	Cargo.		By rail.	
	Tons.	Value.	Tons.	Value.
Lumber	720,321	$5,320,596	1,029,034	$6,055,418
Doors			9,000	590,228
Piano sounding boards			1,500	300,000
Tight coopering			3,000	500,000
Slack coopering	3,210	107,0 0	11,310	377,000
Fertilizer	835	28,830		
Coal tar	125	1,250		
Canned salmon[1]			17,990	294,830
Mild-cured salmon			242	50,000
Canned clams			1,058	211,500
Miscellaneous manufactures, pine wood			300	27,500
Whale oil			1,774	145,204
Total	724,491	5,457,676	1,075,288	8,551,680

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[1] Attention is invited to the apparent discrepancy of quantities and values of these items.

IMPORTS.

Shipments.	Cargo.		By rail.	
	Tons.	Value.	Tons.	Value.
General merchandise	27,565	$1,609,875	359,685	$7,373,542
Fuel oil[1]	90,200	58,700	270,000	116,400
Total	117,765	1,668,575	629,685	7,489,942

	Tons.	Value.
Total water shipments in and out	842,256	$7,126,251
Total rail shipments	1,704,973	16,041,622
Total	2,547,229	23,167,873

[1] Attention is invited to the apparent discrepancy of quantities and values of these items.

It is claimed that, conservatively estimated, a difference of 75 cents per 1,000 feet of lumber exists against the port as compared with Puget Sound ports. This amounts to about $125,000 per year on present shipments and is due to the fact that the most economical vessels engaged in the lumber trade have a carrying capacity of some 2,500,000 to 3,500,000 feet and draw about 25 feet. The maximum permissible draft of vessels loading at Grays Harbor is now 19 feet 6 inches. This permits the loading of partial cargoes only, and vessels now complete their cargoes on Puget Sound or British Columbia waters. Another disadvantage of present insufficient depth is claimed to be loss of export trade. Lumber is estimated to be worth $2 more per 1,000 in foreign markets than in the domestic trade. The normal amount of lumber manufactured at Grays Harbor suitable for export is estimated at 40 per cent of the whole. In 1913 only 20 per cent of the output was sold abroad, so that the loss in that year was $2 per 1,000 for 20 per cent of the whole, or about $150,000. The lumber manufacturers of Grays Harbor have shipped large amounts by rail. During the last six years these rail shipments have increased 400 per cent. It is claimed that the cost of transportation in deep-draft vessels via the Panama Canal will be $11 per 1,000 less than present rail rates to New York.

Due to the fact that steamers of the class usually engaged in the export lumber trade can take out part cargoes only, manufacturers of Grays Harbor have received notice from practically all the shipping firms on the Pacific coast that it may be necessary to discontinue service from Grays Harbor for outward bound cargoes.

The commercial representatives of Grays Harbor estimate that the reduction in freight rates on the present commerce, due to securing and maintaining the project depth, would be $1,741,000 per annum. They claim that an incidental advantage of securing and maintaining the project depth will be an increase in stumpage values of $1 per 1,000 feet board measure, or of $100,000,000 in the value of timber lands tributary to Grays Harbor. This increase would be directly beneficial to the owners of the land, among whom are the United States and the State of Washington.

43. The character, amount, and steady growth in the commerce of the port is indicated by the tables in paragraphs 39 and 42.

V. LOCAL COOPERATION.

44. A port commission was created by act of Legislature of the State of Washington, March 14, 1911. It controls all waterways embraced in the port and is direct owner of 90 acres of tide and shore lands valued at $120,000. The Chehalis County lines are the geographical limits of the port. The commission has power to levy taxes and to issue bonds to the value of 3 per cent of the taxable assets of the county and has at present in hand about $100,000.

45. In the event of the resumption of jetty work by the United States the commission has offered to build a wharf for receiving stone.

46. The commission has gone on record that they will not ask any help from the General Government for the improvement of the inner harbor and that this improvement would be of such scope as was warranted by the depths over the bar.

47. Comprehensive plans for this improvement, including the building of wharves and docks and the making of water and rail connections, have been adopted by the port. The projected expenditure is estimated at $750,000.

VI. METHODS AND COSTS OF FURTHER IMPROVEMENT.

48. The board considered the following methods of carrying on the improvement of Grays Harbor Bar:

(*a*) Extending one or both jetties.
(*b*) The raising of existing jetties.
(*c*) Dredging.

49. *Extending one or both jetties.*—For condition of jetties at present time see paragraphs 33 and 34. Both jetties were constructed by the method followed at the exposed harbors of the north Pacific coast; that is, by dumping rock from tramways on double-track pile trestles. The usual difficulties were encountered through annual wreckage of portions of the trestle during the winter season. The ends of the jetties are now about 1½ miles from the crest of the bar. The depth of water in which extensions of the jetties would be carried on is about 24 feet. This depth would be increased by scour during construction. The damage inflicted by storms on the outer ends of the present jetties indicates the necessity for relatively heavier sections for extension.

The estimates of cost for extending the jetties are based on construction in the manner outlined above, which, in addition to actual extension, involves the repair of the trestle of the north jetty, the entire reconstruction of the trestle on the south jetty, the maintenance of both trestles during progress of the work, and the placing of a sufficient quantity of rock to preserve the trestles during the construction period. Estimates of cost appearing hereafter were prepared under direction of the board by the district officer, Seattle, a member of the board.

The estimated costs are as follows: For the extension of both jetties to the lengths originally recommended by the division engineer (1895), $4,472,000; for extending the north jetty to the distance recommended by the district officer, 5,500 feet, without any work on the south jetty, $1,775,000. These extensions carry neither jetty to the present crest of the bar. (For detailed estimates, see Appendix A.) While estimates were not prepared for extending the jetties beyond the lengths above mentioned, it may be stated that any additional extension beyond these points will cost approximately $300 per linear foot.

50. *Raising the jetties.*—Two methods of raising the jetties have been considered, namely, by dumping rock from trestles and by means of self-propelled derrick lighters. The trestle method should be used for raising the north jetty, inasmuch as the trestle is already in place and is being now repaired for further work with current appropriation, and the required quantity of rock may be placed in one season. A considerable portion of this trestle, however, is already nearing the end of its effective life, and to avoid expensive repairs amounting to almost entire renewal it would be necessary to complete the raising of the jetty during the season of 1915. The construction and maintenance of rubble jetties by self-propelled derrick lighters is not uncommon, but has not been attempted at north Pacific ports, where working conditions are exceptionally severe. The lighter method, however, has been used at other Pacific ports and the principle involved is the same as in the case of vessels discharging and taking on cargo in open roadsteads, which is not an uncommon occurrence. The restoration of the south jetty by the trestle method would require the entire reconstruction of the trestle, which has completely disappeared, and would therefore involve a high plant cost per ton of rock placed. If the lighter method be found practicable, the heavy expense of construction and maintenance of the trestle would be saved. Sufficient depths are found along the north side of the south jetty to accommodate lighters of considerable draft. The preliminary expense involved in the trial of this method of construction includes the first cost of a lighter, estimated at $120,000, and $40,000 for its operation during one season. In the event of a failure not involving the loss of the lighter, the plant would be available for transfer to another port where the exposure is less.

In connection with jetty raising the board has also considered the question of maintenance. Two systems of maintenance by the trestle method are applicable: First, the placing of a sufficient quantity of rock when the jetties are raised to reasonably assure their maintenance at an effective height for a considerable time; second, the depositing of such a quantity of rock each season as will be required to protect the trestle and to replace settlements and damage by storms. The first method involves the entire reconstruction of the trestle at long intervals and the second method involves the continual maintenance of the trestle by annual repairs. The estimates prepared by the board indicate that the first method (entire reconstruction at considerable intervals) would be the more economical provided sufficient stone be placed to insure the effective preservation of the jetty for at least 10 years, especially as a longer effective life is certain to be accomplished by each renewal. Should the method by use of steam lighters be demonstrated as practicable, it would offer its greatest field of usefulness in maintenance work for reasons already stated. The estimate of the board for raising the north jetty by the use of the existing trestle, which involves the placing of sufficient rock to give an effective life of 10 years, is $560,000. A similar estimate for the raising of the south jetty is $870,000.

51. *Dredging.*—Experience at jetty harbors on the Atlantic and Gulf coasts has proven that the self-contained hydraulic dredge is a useful adjunct in improving bar channels and especially in maintaining them.

On the north Pacific coast bar dredging has been tried at Coos Bay and at the mouth of the Columbia River. For data concerning this work attention is invited to Appendix B, which is a memorandum furnished the board at its request by the district officers of the Portland (Oreg.) districts, both of whom are members of this board.

The principal differences between north Pacific ports and Gulf and Atlantic ports are that in the case of the former shifting of the bar channel is more rapid, and, due to the greater severity of the winter storms, dredged channels shoal more rapidly and working conditions are more severe. On account of bad weather it is rarely possible for bar dredges to work on the Oregon and Washington coast during the period of about five months from November to March, inclusive.

Channel depths over the Grays Harbor bar have usually been greatest at "breakouts" and have decreased as the channel shifted to the north. The principal channel now crosses the bar well to the north of west and is therefore in a position where least depths are usually found. Notwithstanding its location it has a depth of 24 feet, a greater depth than has heretofore been found in a channel in this section of the bar. There are indications of a breakout in the near future. Judging from the depth of the present northwest channel and from the fact that the concentration caused by the jetties is greater than at any previous breakout, it is believed that in the next breakout greater depths will be found than the 24 or 25 feet usually found at such times. Should this be the case the project depth will obtain through a considerable portion of the northward swing of the channel, and dredging may be devoted to an attempt to keep the channel in a favorable position across the bar.

At the present time the project channel could be obtained by the removal of about 300,000 yards more than would be deposited in the cut by natural causes during the working period. Three hundred thousand yards is well within the probable season's performance of a dredge of the capacity and draft of the *Col. P. S. Michie.* For best results it would be necessary for the dredge to hold the natural channel in the favorable section of the bar, or, failing this, to maintain there an artificial channel irrespective of the position of the natural channel. It would also be necessary to remove during the summer season a quantity of material greater than that which is deposited during the winter season.

The cost of a suitable dredge for work on the Grays Harbor bar is estimated at $450,000. To operate it would cost about $60,000 a year, considering repairs and depreciation at 5 per cent, the annual expenditure necessary for dredging would be $82,500.

VII. FINDINGS AND RECOMMENDATIONS.

52. From the review of commercial conditions contained herein (Sec. IV) the board believes that the securing of a permanent channel of the project depth would materially increase the traffic of the port and decrease shipping rates.

53. The board believes that had the jetties been constructed in lengths and position as originally recommended by the division engineer in 1895 the project depth would have been obtained. As actually constructed, however, the jetties are about 5,000 feet short of the lengths so recommended. The board further believes that were the jetties now extended to the lengths originally proposed the project depth would be obtained. The cost of extending the jetties in accordance with this project is estimated at $4,472,000. The board is of the opinion that this expenditure is not warranted.

54. With reference to the project of the district engineer officer for a 5,500-foot extension of the north jetty, the board believes that the results that might be reasonably expected would be incommensurate with the cost which was estimated by him at $1,775,000.

55. Referring to the inquiry of the Board of Engineers for Rivers and Harbors (par. 3) the board is of the opinion that the same objection would apply to an extension of the north jetty beyond the point proposed by the district officer and to any extension of the south jetty.

56. The board believes that with jetties in their present condition the action of a dredge alone would not secure the project channel.

57. Based on results at other jetty harbors, the board has no confidence that a 24-foot channel, however obtained, would maintain itself by action of jetties alone, but believes that dredging will be necessary for maintenance.

58. The board believes that restoration of the jetties to effective heights would secure sufficient additional scour so that with the assistance of a dredge the project channel would be obtained.

59. The board believes that the raising and maintenance of jetties by the lighter method offers sufficient prospect of economical application at Grays Harbor to warrant its trial.

60. The board believes that the trestle method should be used for the raising of the north jetty and that it be also used for the raising of the south jetty unless experiments indicate that this work can be more economically carried out by the use of self-propelled derrick lighters.

61. The time required for the raising of the north jetty, provided the work is started immediately, as it should be to take advantage of the existing trestle, is one year.

62. The board believes that in order to avoid duplication of plant, work on a south jetty trestle should not be begun until work of raising the north jetty is completed. The time required for actual construction of the south jetty is three years. The experiment to determine the practicability of the lighter method should be undertaken during construction of the north jetty, so that the raising of the south jetty would not be unnecessarily delayed.

63. The board estimates the cost of restoration of the existing jetties at $1,430,000, the cost of construction of a dredge at $450,000,

and the annual cost of operating the dredge at $82,500. (See Appendix A.) The board believes that the present and prospective commercial conditions at Grays Harbor and the probability of obtaining satisfactory channel conditions as the result of the above work are sufficient to justify the United States in undertaking this project.

64. The board therefore recommends:

(*a*) The immediate restoration of the north jetty at an estimated cost of $560,000.

(*b*) The restoration of the south jetty at an estimated cost of $870,000.

(*c*) The purchase or construction of a suitable dredge for work on Grays Harbor Bar at an estimated cost of $450,000 and its operation at an annual estimated cost of $82,500, and in the meantime that a dredge be borrowed for this work if possible.

65. With reference to the special subjects laid before it by letter from the Board of Engineers for Rivers and Harbors (see par. 3), it will be observed that—

(*a*) The board recommends "raising the south jetty."

(*b*) The board does not recommend "extending the south jetty."

(*c*) The board does not recommend "extending the north jetty beyond the point proposed by the district officer," but recommends its restoration without any exension.

(*d*) The board recommends the "use of dredging to increase depth on the bar" and also to maintain the bar channel.

(*e*) The board does no recommend "larger cooperation by local interests" but believes that the cooperation offered by the port commission (par. 45) is adequate for present conditions.

(*f*) Grays Harbor Bar is worthy of further improvement to the extent and at the cost set forth in paragraph 63.

(*g*) The board believes that the expenditure recommended above is "the probable limit of further expenditures that may be required to secure the project depth" and is the maximum expenditure that present conditions justify.

66. The first appropriation should be sufficient to provide for:

(*a*) Completing the work on the north jetty to take advantage of the existing trestle during the working season of 1915; (*b*) constructing a lighter and operating it for one season; (*c*) starting construction of a dredge and operating a dredge if one can be borrowed; a total of $900,000. There should be continuing contract authorization of the balance, which should be appropriated in the two succeeding years. The board desires to especially recommend that provision be made for restoration of the north jetty, estimated at $560,000, at the earliest possible date in view of the fact that any postponement of this work will add greatly to its cost.

67. There are no questions of flood protection or water powers involved. For information regarding terminal facilities see paragraph 40.

Thos. H. Rees,
Lieutenant Colonel, Corps of Engineers.
Chas. L. Potter,
Lieutenant Colonel, Corps of Engineers.
C. H. McKinstry,
Lieutenant Colonel, Corps of Engineers.
Jay J. Morrow,
Major, Corps of Engineers.
J. B. Cavanaugh,
Major, Corps of Engineers.
T. H. Dillon,
Captain, Corps of Engineers, Recorder.

APPENDIX A.

DETAILED ESTIMATES.

[Prepared under the direction of the board by the district officer, Seattle, Wash., who is a member of the board.]

1. EXTENSIONS.

The estimates are based on an average depth of 30 feet of water at mean lower low water for both extensions.

The estimates are for a double-track trestle, same as existing trestle on north side, and for a crest of enrockment 5 feet above mean lower low water and 20 feet wide on top. Side slopes 1 on 1½, 115 pounds per foot of cross section.

(a) *North jetty, 5,000 feet extension.*

Tramway, 5,000 feet, at $10 per foot	$50, 000
Wharf	20, 000
Addition to plant	35, 000
Stone, 625,000 tons, at $2 per ton	1, 250, 000
	1, 355, 000
Add 20 per cent for contingencies	271, 000
	1, 626, 000
Maintenance for first year:	
Storm damage to trestle	10, 000
Stone, 40,000 tons, at $2.50 per ton	100, 000
	110, 000
Add 20 per cent for contingencies	22, 000
	132, 000
Annually thereafter if regularly maintained by the trestle method:	
Storm damage	10, 000
Stone, 20,000 tons, at $2.50 per ton	50, 000
	60, 000
Add 20 per cent for contingencies	12, 000
	72, 000

(b) *South jetty, 4,500 feet extension.*

Tramway, 4,500 feet, at $10 per foot	45, 000
Plant, 1 pile driver	10, 000
Stone, 562,500 tons, at $2 per ton	1, 125, 000
	1, 180, 000
Add 20 per cent for contingencies	236, 000
	1, 416, 000
Maintenance first year:	
Storm damage to trestle	15, 000
Stone; 40,000 tons at $2.50 per ton	100, 000
	115, 000
Add 20 per cent for contingencies	23. 000
	138, 000

Annually thereafter if regularly maintained by the trestle method:

Storm damage	$15,000
Stone, 20,000 tons, at $2.50 per ton	50,000
	65,000
Add 20 per cent for contingencies	13,000
	78,000

II. RESTORATION OF PRESENT JETTIES.

These estimates for jetty restoration contemplate the deposit of sufficient stone in the outer portion of the jetty to keep it in effective condition for 8 to 10 years.

(*a*) *Estimate for restoration of north jetty, Grays Harbor, based on having funds available for placing total amount of rock in 1915 and that $110,000 is now available.*

Replacing 1,000 piles destroyed by teredo limnoria, at $16 per pile	$16,000
200,000 tons of rock, $2.25 per ton	450,000
	466,000
Add about 20 per cent for contingencies	94,000
	560,000

If the jetty is to be regularly maintained by the use of the trestle, the estimated cost of so doing is as follows:

Maintenance, 1916, and annually thereafter:

Replacing 1,500 piles, at $16 per pile	$24,000
Replacing timbers, 260,000 feet, board measure, at $20	5,200
Storm damage	12,500
15,000 tons of rock, at $2.50 per ton	37,500
	79,200
Add about 20 per cent for contingencies	15,800
	95,000

(*b*) *Estimate for restoration of south jetty, Grays Harbor, building trestle and wharf, and raising enrockment to mid-tide.*

Wharf	$10,000
Trestle approach, 6,000 feet, at $5 per foot	30,000
Jetty trestle, 13,734 feet, at $10 per foot	137,340
Maintenance of trestle while building; 2 years, at $30,000 per year	60,000
Plant [1]	10,000
Buildings and water system	3,500
Three groins 300 feet long, at $25,000 each	75,000
160,000 tons of rock, at $2.50 per ton	400,000
	725,840
Add about 20 per cent for contingencies	144,160
	870,000

If the jetty is to be regularly maintained by the trestle method, the estimated cost of so doing is as follows:

Trestle, first year	$30,000
Rock, 30,000 tons, at $2.50 per ton	75,000
	105,000
Add about 20 per cent for contingencies	21,000
	126,000

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[1] It is thought that part of the plant now in use on the north jetty will be available for the south jetty, but that the following additional plant will be needed: 1 locomotive, at $3,500; 3 flat cars, at $700; 3 derricks, at $1,000; and 1 boiler, at $1,000; total, $9,600; say $10,000.

Annually thereafter:

Trestle	$30, 000
Rock, 15,000 tons, at $2.50 per ton	37, 500
	67, 500
Add 20 per cent for contingencies	13, 500
	81, 000

The estimate of the amount of stone for raising the south jetty to mid-tide is based on the following data:

(*a*) Length of section:	Height of crest referred to mean lower low water.
2,000 feet	2. 5
1,700 feet	2. 0
2,700 feet	1. 0
1,700 feet	0. 0
2,500 feet	—1. 5
1,000 feet	—3. 0

(*b*) It is assumed that the enrockment at present has a top width of 10 feet and side slopes of 1 on 3, rock on the north side and sand on the south.

(*c*) In filling the first year it is assumed that the enrockment will take a cross section 8 feet wide on top and side slopes of 1 on 1½, later, in subsequent years as the settlement is overcome, taking a section 10 feet wide on top, and side slopes of 1 on 2. One hundred and fifteen pounds per cubic foot of section is used.

(*d*) The cost of stone is estimated at $2 per ton in place in large quantities, and at higher figures for smaller quantities.

TRESTLES FOR RESTORATION AND MAINTENANCE OF PRESENT JETTIES.

In driving a new inshore trestle for the north jetty a rate of progress of 2½ bents per day is assumed, which will make the labor cost $24 per bent. This, with the additional cost of $46 per bent for trestle piles, makes the cost per bent $151.61, or about $10 per foot.

The cost of trestle approach for the south jetty is estimated at $5 per foot, as the average length of piles would be 30 feet, and it is thought that they could be obtained for not exceeding 12 cents per foot in place, and the lumber for $15 per 1,000 in place, making the cost per bent $53.55, or about $5 per foot.

Double track, tracks spread 15 feet center to center, 16-foot bents, 4 piles, caps 12 by 12 inches by 24 feet, stringers 12 by 14 inches by 32 feet, 30-pound rails, rails laid on stringers.

Piles, untreated, 15 cents per linear foot.
Lumber, $12 per 1,000.
Rails, $50 per ton.
Iron, 3 cents per pound.
Pile points, $2.50 per pile, or $10 per bent.

MATERIAL PER BENT, 70-FOOT PILES.

Piles, 280 linear feet, at $0.15 per foot	$42. 00
Lumber, 1,280 feet, board measure, at $12 per 1,000	15. 36
Rails and connections, 700 pounds, at $50 per ton	17. 50
Iron, 75 pounds, at 3 cents per pound	2. 25
Sway braces	4. 50
Pile points	10. 00
	91. 61
Labor	60. 00
Total	151. 61

or $10 per linear foot.

The cost of operating pile driver with tender is $60 per day, and on account of the almost constant break on the south jetty and the probable difficulty in driving piles in rock deposited 14 years ago a rate of progress of one bent per day is assumed.

III. Summary of Estimates.

1. Restoring and maintaining present jetties:	
Construction:	
(*a*) Raise south jetty	$870,000
(*b*) Raise north jetty	560,000
	1,430,000
Annual maintenance if undertaken by trestle method:	
(*a*) North jetty	95,000
(*b*) South jetty	81,000
	176,000
2. Dredging:	
Cost of dredge	450,000
Repairs and depreciation, 5 per cent annually	22,500
Operation	60,000
	82,500
3. Extending present jetties, and maintenance:	
New construction:	
(*a*) North jetty, 5,000-foot extension	1,626,000
(*b*) South jetty, 4,500-foot extension	1,416,000
(*c*) Raising both jetties as in 2[1]	1,430,000
	4,472,000
Annual maintenance of extended jetties if undertaken by the trestle method:	
(*a*) North jetty, present length	95,000
(*b*) North jetty extension	72,000
(*c*) South jetty, present length	81,000
(*d*) South jetty extension	78,000
	326,000
4. Project recommended:	
(*a*) Construction:	
Raising north jetty	560,000
Raising south jetty	870,000
	1,430,000
Dredge	450,000
Total	1,880,000
(*b*) Annual maintenance:	
Operation of dredge	60,000
Repairs and depreciation (dredge), 5 per cent	22,500
	82,500

Appendix B.

Memorandum of operations of U. S. dredges "Colonel P. S. Michie" and "Chinook," furnished at request of the board by the district officers of the Portland, Oreg., districts who are members of the board.

I. U. S. DREDGE "COLONEL P. S. MICHIE."

The U. S. dredge *Colonel P. S. Michie*, designed and constructed for work on the Coos Bay Bar, was completed about a year ago and commenced work on the bar January 24, 1914. She is a new type of dredge in the United States engineer service, having a single well and single suction instead of the usual pair of side drags. The intake pipe is inclosed in a heavy rigid trussed arm, to which the drag head is firmly attached. The dredge arm has a motion about trunnions, one of which contains the suction intake. The arm is suspended from a heavy "A" frame and is raised and lowered by a heavy winch and a three-part cable. The trunnions are amidships and are only 4 feet above the keel of the vessel. The arm is protected against side thrusts by a truss that extends up into the well, fitting closely in guides provided in the well for that purpose. The vessel has six bins flanking the central well amidships. The boilers are forward of the bins, the engines and pump aft. There is a single 26-inch pump. The vessel is 242 feet long over all, has 42 feet beam, draws 9 feet forward and 11 feet aft when light and 17 feet when loaded.

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[1] Jetty raising is necessary preliminary to jetty extension.

Dredging commenced on January 24, 1914, and continued on the few occasions when work was possible during January, February, and March. Really effective work was not possible until April. During April and May she removed about 106,000 cubic yards. On May 29 she was rammed by the steamer *A. M. Simpson* and lost 38 days of good working weather, resuming operations on July 6. During the remainder of this month and the first half of August she removed about 82,000 cubic yards. It became necessary to suspend operations for lack of funds August 15. She resumed work October 7, but was withdrawn because of unfavorable weather October 23. Altogether she was available for work on Coos Bay Bar 183 days between January 24 and October 23, inclusive, during which time she was able to work on the bar parts of 72 days—in all, 404 hours, of which 247½ hours were employed in actual pumping.

During this time she removed from the bar and dumped at points about 1 mile to seaward 224,394 cubic yards of sand. She was out of commission twice for a total of 90 days during the most favorable working season. It is believed that had she been in commission during these two periods she would have removed an additional quantity of about 225,000 yards. Depths on the bar were increased from 17 feet to 22 feet until suspension of operations, on August 15, but during the subsequent idleness shoaled about 18 inches.

Until May 29 she worked eight hours each day and since that time as many daylight hours as the condition of the bar permitted.

The maximum amount dredged in any one day was 7,426 cubic yards, on August 14. She has filled the bins with about 1,250 yards in about one hour.

The following table shows her work on the bar for each month:

Table of "Michie's" work at Coos Bay Bar, by months, in 1914.

Month.	Days on which she dredged.	Time worked.		Time pumping.		Amount excavated.	Maximum day's work.	Remarks.
		H.	*m.*	*H.*	*m.*	*Cu. yds.*	*Cu. yds.*	
January	2	8	30	4	45	4,719	4,552	Dredge commenced Jan. 24.
February	6	20	16	11	19	10,308	3,280	
March	8	26	42	14	54	14,890	4,094	
April	15	94	24	57	17	47,720	4,650	
May	18	117	15	74	00	58,227	4,893	Rammed May 29.
June								
July	13	82	40	49	50	51,264	7,418	Resumed July 6.
August	7	44	30	28	45	80,687	7,426	Laid up Aug. 15.
September								
October	3	9	35	6	40	6,579	3,032	Resumed work Oct. 7, withdrawn Oct. 23.
Total	72	403	52	247	30	224,394		

The dredge is believed to be slightly deficient in boiler capacity, and when operating with the original drag head, in power. These defects were enforced on her by lack of funds, the alternative being at least a year's delay in construction. It is proposed to increase her boiler power during the coming winter season. With this increased power, with a smaller drag head (which has been experimented with) and a few minor modifications, it is believed that she will be able to remove well over 500,000 yards of sand from the Coos Bay Bar in the working season. She has demonstrated the fact that she can work in slightly heavier seas than dredges of her size of the side-suction type and it is believed that with more steam and the smaller drag she can operate in still heavier seas.

II. U. S. DREDGE "CHINOOK."

1. The *Chinook*, originally the commercial steamer *Mohawk*, later the Army transport *Grant*, has a length of 460 feet over all, a beam of 49 feet, and as

now ballasted draws 17 feet light and 23 feet 7 inches loaded. She was transferred from the Quartermaster Department to the Engineer Department in 1903. The pumping equipment originally installed (1903) consists of two 20-inch pumps; in 1914 two 30-inch pumps were added. She is of the side-suction type. Her two bins have an aggregate capacity of 3,600 yards.

2. Dredging on the Columbia River bar with the *Chinook* encountered many obstacles in the beginning due to the fact that the vessel drew too much to be safely used on the bar except at high water and in good weather, and expensive repairs and alterations were needed for which funds were not at once available. The practicability of dredging on this bar was shown early, however, and based on the *Chinook's* performance a dredge was recommended and obtained for Coos Bay.[1]

3. Information as to the dredging done by the *Chinook* is contained in the following tables:

TABLE I.

[Up to 1914, two 20-inch pumps; in 1914, two 20-inch and two 30-inch pumps.]

	Days or parts of days.	Removed from bar.	Per day.	"Days" on bar compared with calendar period.	Cost per cubic yard.[2]
		Cu. yds.	*Cu. yds.*	*Per cent.*	
May-November, 1904	111	339,583	3,059	51	$0.143
September-December, 1910, May and June, 1911	62	212,080	3,420	78	.08159
June, 1911-July 2, 1912	117	449,538	3,842	35	.0961
June 16-Oct. 15, 1913	69	486,627	7,052	57	.08
July 8-Oct. 31, 1914	49	538,560	10,990	42	....
Total	....	2,026,388	....	....	....

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[1] This project (dredge for Coos Bay Bar) rests upon the successful use of a hydraulic dredge in dredging an ocean bar in the somewhat turbulent waters of the north Pacific coast, an experiment that has not yet been put to a thorough and successful test. The only example of a seagoing hydraulic dredge on this coast is the large dredge *Chinook*, converted from the transport *Grant*, and the only place where she has been tried is on the Columbia River bar. The experiment was brief, partly because the dredge drew too much water for economical and continuous dredging in the depth then existing in the bar channel and partly because her boilers had become unsafe from age and corrosion. From this brief test it was concluded by some that the cost of dredging was out of proportion to the benefits obtained and the use of a dredge as a means of improvement auxiliary to the jetty extension not a success. In my opinion, the experiment was all too brief and the conditions of the experiment too unfavorable to justify the conclusion that dredging of ocean bars on the north Pacific coast under normal and proper conditions will not be successful. This opinion is concurred in by nearly all ocean bar navigators with whom I have conversed, who are all convinced that a resumption of dredging by the *Chinook* on the Columbia River bar, with a comparatively narrow crest to work over, and with a depth of water such as now exists, would prove a decided success in increasing the bar depth. It was hoped to make a second trial with the *Chinook* the past season, but this could not be done, because the last river and harbor bill made no provision for a new equipment of boilers.

In the absence of any conclusive test with a bar dredge on this coast, reference is made to the very general use of sea-going bar dredges in connection with jetty improvements on the Atlantic and Gulf coasts, such as Galveston, mouth of the Mississippi River, St. Johns River, Charleston, and other points. At all points their use has been eminently successful and it is reasonable to expect correspondingly good results from their use on the Pacific coast, though it is not to be anticipated that the same measure of success will follow their employment in the heavy surf of the north Pacific as in the quieter waters of the Atlantic and the very smooth waters of the Gulf. It is believed that the average sea and weather conditions at Coos Bay will allow at least six months of dredging each year which should be sufficient to make a decided impression upon the comparatively short channel across the bar. No opinion is ventured, however, as to the depths that may be secured by dredging, though a very confident hope is entertained that the result will fully justify the expense involved and may exceed expectation, as the bar is narrow and the amount of material to be removed for each foot of depth gained is comparatively small. (Col. G. W. Roessler, Corps of Engineers, in report to Chief of Engineers, dated Feb. 19, 1908, H. Doc. No. 958, 60th Cong., 1st sess.)

After a full study and discussion of the subject, the Board of Engineers for Rivers and Harbors, has arrived at the conclusion that the work of restoring and extending the jetties (jetty at Coos Bay) is not justified by the present and prospective commerce involved, but that the locality is worthy of improvement by dredging in accordance with Plan 1, contained within, at an estimated cost of $500,000. This plan has the decided advantage of providing a first-class sea-going dredge which may perhaps be available for use at other localities, if it is found from experience that its use will not be continuously required at Coos Bay to maintain the necessary depth. (Report of Board of Engineers for Rivers and Harbors, May 11, 1908, ibid.)

[2] Cost of dredging on bar and in estuary.

TABLE II.—*Details for 1914.*

	Pumping time.	Dredged.	Per hour.	Dredged per minute.
	Hours.	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*
July	96.9	178,260	1,838	31
August	116.0	209,640	1,807	30
September	63.6	127,820	2,010	33
October	11.7	22,840	1,959	32
Total	....	538,560	....	....

4. When the bar is too rough for work, the *Chinook* dredges the channels in the lower part of the estuary. The quantities dredged in the estuary in the periods referred to in the first column of Table I, preceding paragraph, were 20,500, 510,351, 542,748, 177,544, and 713,965 cubic yards, respectively; total, 1,965,108. Grand total for bar and estuary, 3,991,496. Total on bar and in estuary for July 8–October 31, 1914, 1,244,575.

5. The *Chinook* would be steadier in a seaway if she had more beam. She lacks boiler and engine power to move against the swiftest currents with all drags down.

6. As to the channel work accomplished by the *Chinook*, no analysis of the operations prior to 1913 is now possible. The least depth on the dredging range in May, 1913, was 25 feet. The dredge worked between June 16 and October 16, 1913. The least depth in the cut in September, 1913, was 28 feet except at one place where there was but 27 feet. The width of the cut was 600 to 700 feet. In May, 1914, the least depth in the cut was 27 feet, showing a deterioration of about 1 foot. It should be noted that there was a general lowering of the bar of about 1 foot on either side of the dredged cut during the period September, 1913, to May, 1914.

7. In 1914, the *Chinook* began dredging on the bar on July 8 and is still at work, although since October 1, she has been able to do but little effective work on the bar. The survey of September, 1914, showed a least depth in the cut of 30½ feet with a 30-foot channel, not quite straight, about 200 feet wide. There had been a general shoaling of the bar on both sides of the cut, especially on the east side where the depth decreased from 27 to 23 feet.

APPENDIX C.

LETTER OF ASSOCIATED COMMERCIAL BODIES OF GRAYS HARBOR, WASH.

ABERDEEN, WASH., *April 22, 1914.*

GENTLEMEN: Your petitioners, the commercial bodies of Grays Harbor, respectfully submit, in compliance with your invitation of April 4, 1914, the following statements and arguments, bearing upon the necessity for the further improvement of Grays Harbor in the interests of commerce and navigation.

The people of Grays Harbor are exceedingly surprised at the findings of the board of engineers and feel that there are strong arguments and facts that possibly have not been clearly set forth to the board of engineers, which in their belief are sufficient to justify a different finding than that set forth in the public notice issued from the board of engineers' office on April 4, 1914.

Prior to 1894 the settlement of Grays Harbor country had only fairly begun. There were three or four small towns aggregating a population of about 7,000 people and possibly another 1,000 persons were scattered throughout the county of Chehalis.

The river and harbor bill, passed in the summer of 1894, carried with it an order for an examination and survey of Grays Harbor and bar entrance with a view to its improvement. This survey was made in October, 1894, under the direction of the district officer, Capt. Thomas W. Symons, at that time located in Portland, Oreg. Based upon the survey at that time made, Capt. Symons submitted a project for the improvement of the entrance to Grays Harbor, by the construction of a single jetty, jutting out from the south headland a distance of 18,200 feet, and estimated the cost of the same at about $1,000,000. His plan and estimate was reviewed by the division engineer, Col. George H. Mendall, of San Francisco, who thought that it would be necessary to build two such jetties extending out about the same distance, one from each headland, and estimated the cost at $2,363,309.

The Board of Engineers for Rivers and Harbors and Congress accepted the plan as submitted by Capt. (now Col.) Symons, and a favorable recommendation was made.

Appropriations were made from time to time for the construction of the south-side jetty, which work was economically and ably carried out to completion under the direction of Capt. Harry Taylor, of the Corps of Engineers, who found that the currents caused such a great scour along the site for the jetty that it was actually constructed in much deeper water and only to a distance of about 13,000 feet from the shore line, its crest when completed being only to a height of ordinary high tide, or about 8 feet above low water. There the jetty stopped 1 mile short of its projected length. Congress failed to make further appropriations for this work until about 1907, when, upon the recommendation of the United States Engineers, an appropriation was made for the extension of the north-side jetty a distance of a mile, and a further appropriation was subsequently made for the extension a considerable distance farther. In this condition, approximating 13,000 feet from the high-water line on the north side, is the end of the present north jetty, with its trestle and track intact and rock pile raised to an elevation approximating mean high tide.

Recently the district and division engineers reviewed the situation under order of Congress and favorably recommended the extension at this time, while the track and trestle and false work of the jetty were yet intact, a distance of 5,500 feet farther, its ultimate length, at a cost estimated at $1,775,000.

This, upon review by the Board of Engineers for Rivers and Harbors, brings your petitioners to submit this petition and argument that Grays Harbor as a port is worthy of further improvement by the General Government, at least the extension of the north-side jetty to the length recommended by the district engineer, Maj. J. B. Cavanaugh.

The old south jetty has now been beaten down so that the outer side of the rock pile is about at the plane of low tide and therefore gives but little concentrated tidal flow upon the bar, but it fixes the line of deep water, however, by preventing any channel being cut across the south spit, which would tend to divide the channel flow over the bar. Had it been possible to prevent this settlement of the south jetty your petitioners believe that much good would have resulted in the continued concentrated flow of water during the times the water was between the high and low water planes and much greater depths be found on the bar at the present time.

During the last two years of the construction work on the south jetty depths of 20 feet were obtained, and at its close a channel obtained for a time that was 22 feet deep at low tide.

Shortly after its completion the north spit, which had acted as a natural jetty or trailing wall, began to wear away by scour and several important channels crossed it in a northerly and westerly direction, which robbed the concentrated flow from the point on the bar where desired. At the same time the crest of the south jetty began to lower for a mile or more shoreward from its outer end, which allowed the ebbing and flooding tides to spill over, and these circumstances caused a rapid deterioration of the channel depth on the bar.

The present west end of the north jetty is nearly a mile east of the crest of the bar, and your petitioners want it to be extended to the bar at this time while the track and trestle is complete, intact, and free from teredo, as to attempt it at a time when it will have been destroyed by the teredo and wave action will mean a larger expenditure of money, besides causing a delay that will be a serious detriment and damage to the port and its commerce and the present advantages and facilities enjoyed be greatly reduced.

For a time deep-draft vessels came to the port of Grays Harbor and it is our desire that they should come again, as this class of vessel is the one now engaged in economical freighting.

When work was started on the south jetty, having for its object the providing of a 24-foot low-water channel on Grays Harbor, capital became interested and your petitioners and their friends made extensive investments in manufacturing plants, in building logging roads, clearing out watercourses for the flotation of logs, and the building of dams to facilitate the log flotation, until now the investments in these particulars alone amount to many millions of dollars.

In addition to these investments your petitioners and those whom they represent have builded four important towns, Hoquiam, with a population of 16,000; Aberdeen, with a population of 20,000; Cosmopolis, with a population of 3,000; Montesano, with a population of 5,000; besides encouraging settlement in the county of a population approximating 10,000 additional persons, making a total population in the Grays Harbor country now of about 54,000 people. In addition to its own people there are thousands living in tributary counties who look to Grays Harbor as a shipping point.

Grays Harbor has a watershed of over 3,000 square miles and is the natural outlet for the products of the west side of the Olympic Peninsula, of about 1,600 square miles additional, upon which grows the finest timber in Washington.

We think that for the board of engineers to condemn this project now will be construed as an acknowledgment of their inability to solve the problem, and this we do not believe is the case. We believe that it is up to the Nation to keep faith with its petitioners who have made these extensive investments and to see to it that its harbor entrance is improved to the extent of a 24-foot channel. It is estimated that 94,100,000,000 feet of timber is tributary to Grays Harbor and will be manufactured there.

We attach hereto statistics showing the commerce of this harbor for the year 1913.

EXPORTS.

[On permissible draft, 19 feet 6 inches.]

Shipments.	Cargo.		By rail.	
	Tons.	Value.	Tons.	Value.
Lumber	720,321	$5,320,596	1,029,034	$6,055,418
Doors			9,080	590,228
Piano sounding boards			1,500	300,000
Tight coopering			3,000	500,000
Slack coopering	3,210	107,000	11,310	377,000
Fertilizer	835	28,830		
Coal tar	125	1,250		
Canned salmon			17,990	294,830
Mild-cured salmon			242	50,000
Canned clams			1,058	211,500
Miscellaneous manufacturing, pine wood			300	27,500
Whale oil			1,774	145,204
Total	724,491	5,457,676	1,075,288	8,551,680

IMPORTS.

General merchandise	27,565	$1,609,875	359,685	$7,373,542
Fuel oil	90,220	58,700	270,000	116,400
Total	117,765	1,668,575	629,685	7,489,942

	Tons.	Value.
Total water shipments in and out	842,256	$7,126,251
Total rail shipments in and out	1,704,973	16,041,622
Total	2,547,229	23,167,873

EXPORTS.

Estimated yearly gain on 24-foot draft:

Lumber, foreign	$150,000.00
Lumber to Atlantic, 200,000,000 feet, at $3.50	700,000.00
Gain to vessel interests	57,795.96

Estimated yearly gain on 24-foot draft—Continued.

Salmon and clam pack	$22,646.20
Shingles	180,000.00
Tight cooperage	24,868.00
Slack cooperage	8,265.00
Piano sounding boards	9,600.00
Miscellaneous manufacturing	5,000.00
Doors and sash	30,000.00
Oil and fertilizer	14,192.00
Total	1,201,867.16

IMPORTS.

Gain on imports, 30 per cent per 100, or 25 per cent of inbound rail shipments	539,526.00
Total losses, including export and import	1,741,393.16

United States Government timber, 35,062,500 feet, at $1.50, $52,593,750; privately owned and State, 82,562,500 feet, at $1.50, $123,843,750; loss to Government and State on timber not manufactured, 50,000,000 feet, at $5, $250,000,000.

We attach hereto details verifying and explaining above estimates and figures.

LUMBER INDUSTRY.

The main industry of Grays Harbor is the manufacture of lumber and other forest products, and the pay roll from this source amounts to approximately $4,529,496.65 per year. The products of the large number of lumber manufacturing plants on Grays Harbor include fir, spruce, cedar, and hemlock lumber, red-cedar shingles, lath, sash and doors, veneer, baskets, crates, box shooks, ladders, piano sounding boards, wood flour, tubs and pails, and cooperage and cover a wide range of manufacturing, which is being added to each year, and in which there is vast room for greater development. The sash-and-door business has been developed during the past year, and plants having a capacity for turning out over 4,000 finished doors per day are in operation here now.

During the year 1913, 437 steam vessels and 105 sailing vessels moved from this port 425,649,262 feet board measure of lumber and kindred products, or 720,321 short tons, valued at $5,320,596; of this amount 79,434,000 feet went to foreign markets and 346,215,000 feet to domestic markets, or less than 20 per cent of the water shipments being for offshore points; and, as the price on lumber during the year 1913 ruled over $2 per 1,000 feet board measure more for foreign lumber than for that sold on the coast (or, as it is known, domestic market), the loss to the cargo mills was very heavy, as the normal amount of foreign shipments is about 40 per cent of water-borne shipments, or more than double the shipments of 1913. We estimate the loss to the lumber manufacturers on this one item alone for 1913 to be over $150,000. This falling off on shipments was on account of the size of vessels engaged in the trade and due to the fact that many of the vessels would not come to the port and others taking but partial cargoes here and completing their cargo on Puget Sound and British Columbia waters. On all such partial shipments a differential was deducted from the shipper's price to warrant the movement of steamer, and we have no data of what this amounts to, but it usually runs from 75 cents to $1 per 1,000 feet board measure, as it costs the vessel about $500 extra pilotage and about 20 hours' time to shift from this port to next loading port on the Sound or British Columbia, so that the average cost to charterer is from $1,000 to $1,500, depending on the size of the vessel and the time consumed in making the run. On several occasions such vessels have been bar bound here, costing the charterers in one instance about $5,000 for such loss of time and cost of movement.

This is of the most serious consequence and one of the hardest blows at the commerce of Grays Harbor at this time, and is caused entirely by the poor condition at the harbor entrance. It might be well to explain, in passing, that by domestic shipments is meant shipments to California markets principally, to San Francisco and San Pedro, both of which markets are the natural dumping grounds for lumber unsalable elsewhere. The manufacturers endeavor to turn as much as possible of their merchantable into foreign markets and sell their common or lower grades in the domestic market, and when the manufacturers can not ship foreign they must move their product into the other market and sell in competition with others more favored by nature, located either in American or Canadian waters, and whose low-grade product establishes the market price for domestic lumber. In consequence of this the manufacturers of Grays Harbor have been obliged to turn their attention more to the rail trade, and this trade in the past six years has increased nearly 400 per cent.

It costs to ship to the eastern market—say New York, Boston, or Philadelphia and territory at their basis—for freight 75 cents per hundredweight in single-car lengths and 85 cents per hundredweight in double-car lengths. Rough decking costs $24.75 per 1,000 feet for freight alone to the market above mentioned, while rates on the same stock are being quoted at $13.20 for movement through the Panama Canal, or a saving of $11.55 per 1,000 feet.

The saving to the people of this Nation on that item alone will run into figures that are startling, and on account of their magnitude we hesitate to name them, for fear our figures would be considered too optimistic, and our aim is to be ultraconservative and present no data that can not be proven.

While from the nature of the above it is purely speculative, yet you know that commerce, like water, seeks the course of least resistance; and as the past year or two the rail trade was the easiest means of reaching the markets, during the year 1913 there was shipped by railroad to various sections of the United States 416,290,763 feet of lumber, 425,892,125 pieces of shingles, 454,022 manufactured doors, 100 cars of piano sounding boards—this item alone valued at $300,000—tubs and pails and tight cooperage over 200 cars, valued at about $300,000; the slack cooperage amounted to 14,520 tons, valued at $484,000. Of this latter stock 1,830 tons was shipped at an expense of 7½ cents per hundredweight to Puget Sound and Columbia River for transshipment by water, being a loss on this class of business to this one firm of $2,745. Six hundred and ninety tons were shipped by all rail to the Atlantic seaboard, and the differential on this item over rates that are named via the canal would mean a saving on this 690 tons of $5,520, or this one firm would save on a year's business on actual shipments $8,265 if we had good water connection.

Shingles take a 10 cent higher rate by rail than lumber. One Grays Harbor firm in 1913 shipped 39,400,000 to San Francisco at a cost of about 35 cents per 1,000, or $13,790; all of this was transshipped at that point to steamers of the American-Hawaiian Steamship Co., and were handled by that company via the Isthmus of Tehuantepec Railway to the Atlantic seaboard. Many more were moved in the same way, but as they were sold for San Francisco delivery and were later shipped from there, no data of the amount is obtainable. It is conservative to say that 200,000,000 pieces of shingles per year will be moved by water via the Panama Canal to the far eastern coast that we are now marketing by rail. This would mean 20,000 tons. The rail freight at 85 cents per hundredweight would be $340,000. The water rate of not to exceed 40 cents per hundredweight on the item of shingles alone would be saved to the citizens of the nation.

In about 1,500 tons of piano sounding boards about 300 tons of this product went to foreign countries via rail from here. Practically their entire output is sold to Atlantic coast piano manufacturers—Atlantic and tributaries—and up to this time it had all moved by rail, but could be shipped by water with equal ease and at a saving in freight of about $9,600.

On spruce ladders, patent scaffolding, wood flooring, tubs, cooperage, and the product of the numerous small factories whose product is all moving by rail, the same saving in freight could be made, but is estimated at $5,000; while many of the manufacturers are in straightened circumstances operating as they are in the outmost western portion of this Union and moving their output to the populous portion of our country by the most expensive means possible, simply because there are no proper shipping facilities to care for their varying needs.

In explanation of this point, up to this time the vessels engaged in trading in here come under regular charter to move a specific cargo and have no space to take other cargo lots offered, and this system is changing and vessels are now soliciting outside freights for coastwise ports, but from present outlook no far east shipments can be figured on because of the bad repute of the harbor entrance, and the only relief in sight is to move to San Francisco or Puget Sound by water in small vessels at a cost of about $3 per ton besides the loss through damage on account of an extra handling from one vessel to another. The cost promises to be prohibitive for years to come, for the reason that other sections have the same opportunities that are found here, and the natural margin in the trade will not be sufficient to permit the added cost of transportation and factories will leave and new ones can not be hoped for.

Fir doors have sprung into general favor and are the coming door of the world and naturally the market for them is found where the population is dense. The saving in freight in the fir doors made here on Grays Harbor, the yearly value of which will run over $1,000,000, will amount to about $30,000. A fir door will average 40 pounds and the rate at present is 75 cents per hundredweight on any goods sent to the Atlantic for shipment to foreign countries, and 80 cents per hundredweight to our own home market on that coast. Rates of 50 cents per hundredweight have been made by water via Panama Canal, and the foreign shipments in many instances can move direct, saving the long haul across the continent, so that our estimate of this saving is conservative, being much reduced from figures furnished by men in the trade.

LUMBER SHIPMENTS BY WATER FOR THE PORT OF GRAYS HARBOR FOR THE YEAR 1913.

The following report covers the shipments made by tramp steamers (steamers of large tonnage), coastwise steamers, foreign sail vessels, and coastwise sail vessels:

	Feet b. m.
12 tramp steamers having a capacity of	32, 800, 000
12 tramp steamers loaded at this port	17, 630, 000
Total	15, 170. 000

These steamers were compelled to go to other ports to complete their loads and the following is the actual differential as a consequence of having to make this move:

Differential in rate, expense shifting to other ports to complete cargo, 17,630,000 feet, at 75 cents	$13, 222. 50
Loss pay roll to local longshoremen, 15,170,000 feet, at 85 cents	12, 884. 50
Total	26, 117. 00

Loss for bar-bound fleet vessels for 13 months ending January 31, 1914; 71 vessels bar bound 449 days, having a net tonnage of 50,461 tons, whose cargoes amounted to 69,585,000 feet b. m., as follows:

5 foreign steamers, average 2,800 tons, at 8 cents per ton, $224, bar bound 12 days, at $224 per day	$2, 688. 00
31 foreign sail vessels, average 616 tons, at 8 cents per ton, $49.28, bar bound 261 days, at $49.28 per day	12, 862. 08
30 domestic steamers, average 511 tons, average per day, $100, bar bound 147 days, at $100 per day	14, 700. 00
5 domestic sail vessels, average 409 tons, at 8 cents per ton, $32.72, bar bound 29 days, at $32.72	948. 88
Total	31, 198. 96

Interest on investment.—69,585,000 feet b. m. lumber detained at bar 449 days, or 15 months; 71 vessels, average cargo 980,000 feet b. m., at $10 per 1,000 feet, $9,800.

Interest at 4 per cent for 15 months, $490.

Total differential:

Loss account differential in rate, expense shifting, etc	$13, 222. 50
Loss, pay roll	12, 894. 50
Loss, expense to bar-bound vessels	31, 198. 96
Loss, interest	490. 00
Total	57, 795. 96

Lumber cargo shipments from Grays Harbor for 1913.

Foreign steamers	12
Coastwise steamers	425
Foreign sail vessels	74
Coastwise sail vessels	31
Total vessels	542

Foreign shipments amounted to	feet b. m.	79,434,000
Coastwist shipments	do	346,215,000
Total tonnage	net tons	283,758
Total cargoes	feet b. m.	425,649,000

FOREIGN SHIPMENTS.

Attached hereto we beg to submit a copy of a letter signed by nine of the largest shipping firms on the Pacific coast, which is in intent and purpose very similar to letters which have been previously written by each one of these firms to their agents on this harbor.

These firms, when requested to furnish us data covering this subject, decided that it would expedite the matter if they all signed this letter, which they prepared themselves, which accounts for all names appearing in one letter.

San Francisco, Cal., *April 14, 1914.*

Mr. H. M. Delanty,
Manager, Grays Harbor Stevedore Co., Aberdeen, Wash.

Dear Sir: We, the undersigned, are heavily interested in the exporting of lumber to all parts of the world. The quality of the lumber and the facilities of getting the same at the different mills in Grays Harbor are second to none. The steamers we use in the lumber trade are tramp steamers, say, from 2,800,000 to 3,750,000 feet capacity; therefore, with reference to the proposed action of the United States Government in discontinuing the work on the north jetty at Grays Harbor, Wash., we would advise you that in this event we would refuse to send our large tramp steamers to your port as we have done in the past. At the present time our large steamers can only take our part cargo from Grays Harbor, going to other ports in the Northwest to complete, thereby causing us an additional expense for extra freight and cost of shifting. This we have been doing in order to hold certain trade and the hopes that with the proper extension of the north jetty the channel over the Grays Harbor bar would be of such depth as to permit of these steamers carrying full cargoes to sea, as from the ports on Puget Sound or Columbia River. The channel over Grays Harbor bar has been gradually deepening, owing to the effects of the present jetties, but with the stoppage of all work this gain will not only be lost, but in our opinion the channel will most certainly shoal, and in anticipation of this we contemplate discontinuing our steamer service to Grays Harbor for outward cargoes.

Comyn, Mackall & Co.; Balfour, Guthrie & Co., by Reid; J. R. Grace & Co., Rossiter; Robert Dollar Co., Lorber; American Trading Co., Morse; A. F. Thane & Co., by Thane; J. J. Moore & Co., Blair; Hind, Rolph & Co., Meyer; G. W. McNear (Inc.), McNear.

The fishing industry of Grays Harbor is practically in its infancy, yet we wish to submit for your information the following facts and figures covering the industry of the salmon and clam products of this harbor for the year 1913:

	Quantity.	Value.
Packed on Grays Harbor, 1913:		
Canned salmon cases	59,965	$294,829.60
Mild-cured and salt salmon—		
Casks	400	40,000.00
Barrels salt	300	10,000.00
Canned clams cases	47,000	211,500.00

Of the above, practically the entire pack was shipped by rail to eastern markets, some of which was reshipped to the old countries.

We beg to submit the following as being comparative of the rail and water rates in effect at the present time, which we assume will prevail, at least, with the opening of the Panama Canal, using as a base the shipment and pack of the year 1913. The following table will show the differential upon the pack of that date, which the packers at this time state they anticipate will be doubled in the year 1914:

Canned salmon:

3,597,900 pounds, via rail, 70 cents per hundredweight	$25,095.30
3,597,900 pounds, via water, 40 cents per hundredweight	14,391.60
Differential	10,703.70

Canned clams:	
2,115,000 pounds, via rail, 85 cents per hundredweight	$17,977.50
2,115,000 pounds, via water, 40 cents per hundredweight	8,460.00
Differential	9,517.50
Mild-cured and salt salmon:	
485,000 pounds, via rail, at $1	4,850.00
485,000 pounds, via water, at 50 cents	2,425.00
Differential	2,425.00
Total differential on salmon and clam pack for 1913	22,646.20

TIMBER RESERVES OF CHEHALIS COUNTY AND THE AREA OF NECESSITY TRIBUTARY TO GRAYS HARBOR.

The following figures are based upon actual cruises made by the employees of the various counties of this State, embraced in the district covered, together with miscellaneous data furnished to the United States Government, as well as information made for the State of Washington. The cruises made on the various counties and districts comprised in this report have been verified in every instance where it was possible for this committee to verify same. Much data and information has been furnished to us by owners of timber through access to their private cruises, and the statement herewith made is made by experienced land cruisers who, in every case, went upon the land and counted the trees and timber thereon, the work being done in 40-acre tracts, which is considered as nearly as possible an absolute cruise. The timber cruised in the following report was made at a cost in excess of $500,000.

Embraced within the "Grays Harbor watershed" is land equal to 126 full townships of timberland, of which the United States Government owns 36 townships. The Government ownership is all within the Olympic National Forest Reserve, excepting 8 in the Quinault Indian Reservation. The other 90 townships are held by individuals, private corporations, railway corporations, or the State of Washington. The timber within the townships comprised in this report are the townships which will of necessity and naturally come to Grays Harbor.

Of the 126 townships stated above, 20 are in Jefferson County, 11 of these being in the forest reserve; 15 are in Clallam County, 5 being in the forest reserve; 58 are in Chehalis County, 9 of which are in the forest reserve and 8 in the Quinault Indian Reservation; 8 are in Mason County, 3 being in the forest reserve; 3 are in Thurston County; 15 are in Lewis County; and 15 are in Pacific County. This comprises the "Grays Harbor watershed," and all the timber embraced therein naturally comes to Grays Harbor, as can be ascertained by consulting a topographical map of the State of Washington. To take it out any other way would involve a longer and uphill haul that would be practically prohibitive.

On this 126 townships there are 94,100,000,000 feet, board measure, of standing merchantable timber, of which 28,050,000,000 feet is owned by the United States Government. Of this amount—

	Feet.
In Jefferson County	19,000,000,000
Belongs to the Government	10,450,000,000
In Clallam County	15,000,000,000
Belongs to the Government	5,000,000,000
In Chehalis County	34,800,000,000
Belongs to the Government	10,200,000,000
In Mason County	6,400,000,000
Belongs to the Government	2,400,000,000
In Thurston County	2,100,000,000
In Lewis County	10,500,000,000
In Pacific County	6,300,000,000

When the timber estimated as above is delivered and manufactured at the mills, it is safe to estimate that there will be an increase of at least 25 per cent in the above estimate, thus increasing the timber resources of this port 23,525,000,000, due to the fact that unless this timber can be shipped by water that the poorer grade of lumber will be, of necessity, left in the woods or burned in the mills as refuse, due to the fact that the freight rates by rail are so high that No. 3 and No. 4 lumber can not be shipped, entailing an absolute loss of this product, equaling in amount 23,525,000,000 feet. This 25 per cent would be worth at least $5 per 1,000 feet to the manufacturer, or $117,625,000, which amount, of course, the manufacturer will be forced to lose unless this can be shipped by water.

With this 25 per cent increase, there is 117,625,000,000 feet of standing timber on the Grays Harbor watershed, by far the greatest body of standing timber untouched now remaining in the world.

The Government has at the present time 28,050,000,000 feet of standing timber tributary to this port, and as a result of the deepening of this harbor, with an increase of 25 per cent as estimated above, it brings up the total amount of holdings of the United States Government to 35,062,500,000 feet.

The present estimated value of timber tributary to Grays Harbor is $3 per 1,000 feet on the stump, which would make a total valuation of all timber tributary to this harbor $352,875,000.

In event this timber can not be shipped by water, it is safe to estimate that the stumpage will be depreciated at least one-third, or a loss of $117,625,000. Of this the Government would lose $35,062,500. This, as you will note, is a total loss to the entire community of $117,625,000. In view of this fact it would seem as though the United States Government would be warranted in spending a good many millions of dollars in deepening Grays Harbor.

Attention is called to the fact that there are very few ports of entry on the Pacific coast as compared with the Atlantic coast. Commerce of the Pacific coast is rapidly increasing, and we have a right to assume that within the next 10 years the commerce of this port will be at least four times what it is at the present time.

We consider that practically all of the lumber of the Grays Harbor region which goes to eastern points of the United States will go via the Panama Canal if the harbor is deepened so that tramp steamers carrying 3,000,000 or 4,000,000 feet can get in and out over the bar with safety.

The value of the timber which the United States Government owns within the "Grays Harbor watershed" and tributary to this port, at $3 per 1,000 feet, amounts to $105,187,500, and we feel that the United States Government has tributary to this harbor more wealth than is tributary to any other harbor in the United States.

FARM PRODUCTS OF CHEHALIS COUNTY.

We submit the following figures, which were compiled from shipments made from the various cities in Chehalis County, covering the products of this county in part, as the committee have been unable to procure statistics from every part of the county, due to the limited time at their disposal.

The statement as appended hereto covers actual shipments as shown by the railroad agents at the various points, and local consumption are figures taken from merchants. We wish to call your attention to the fact that this report does not cover the actual consumption of produce produced in Chehalis County which has been sold direct to logging camps, mill companies, and other large consumers, which does not go direct from the consumer through the various railroads operating in this county. We wish further to state that in our candid opinion, without exaggeration, we believe the actual consumption of farm products in this county will exceed $4,000,000, and that with the improvement of the bar and additional development of agricultural lands there will be an increase in the production as well as the consumption of farm products much in excess of the above amount. The following figures are compiled from statistics for the year 1913:

Products actually produced and consumed in and by Chehalis County and its citizens.

Butter	$163,000
Milk	78,000
Meats	67,880
Vegetable produce	168,900
Eggs	17,100
Miscellaneous	100,000
Total	594,880

There are thousands of acres of land, in Chehalis County alone, unimproved that is susceptible to improvement as farm land, and to this amount large acreages are added each year. This is one of the most ideal dairying countries to be found in the world, as cattle can roam the fields and do well the entire year in the open. Considerable development along this line is going on at the present time, and several creameries have been established, and one branch of a milk-condensing plant has located in the county within the year. The business is but in its infancy. Our people are lumbermen and loggers attracted to the State of Washington from such States as Michigan, Wisconsin, and Minnesota, and they are not natural farm builders, and we must have a different influx of people before the proper development takes place. They are beginning to come and rapid development is in sight.

RAILROAD TRAFFIC.

Attention is called to the importance of Grays Harbor as a rail shipping center. During the year 1913 there was shipped from this harbor 15,971 carloads of lumber and 1,000 carloads of shingles, all of which went to eastern points.

There were imported by rail 23,279 carloads of merchandise and raw material. The merchandise imported to Grays Harbor for the year 1913 was 27,565 tons, having a valuation of $1,609,875.

During the past few months spur tracks have been constructed from the main lines to the water front by all railroads, and it is expected that a large business will develop from the commodities received by water, as they can now be economically handled from the boats to the cars.

The railroad companies are unable to say what the increased tonnage will be after the opening of the canal, but they anticipate a large increase in the volume of business, and are making improvements to meet the increase.

MINERAL RESOURCES.

The mineral resources of the territory tributary to Grays Harbor can not be estimated at this time, due to the fact that lack of railroad transportation makes it impossible for ore to be mined at a profit.

We have positive proof that there are large coal deposits in this vicinity, and at present one mine is operative, at the present time shipping 2,000 tons per day.

There are operative at this time three companies actively engaged in drilling for oil. Very favorable indications have been encountered, and the report of experienced geologists in the employ of the United States Government and private corporations and individuals indicates that we have a very large oil area.

Attention is only called to these natural resources in order that you may be informed as to the present status of development along these lines.

PORT COMMISSION.

The port commission was created by an act of legislature of the State of Washington, March 14, 1911, and authorized as a port district by a vote of the people of Chehalis County December 12, 1911, and controls all of the waterways embraced in the port of Grays Harbor, subject to the act of legislature of the above date.

The State of Washington, by an act of legislature under date March 3, 1913. deeded to the port commission of Grays Harbor 70 acres of valuable tide and shore lands located at Cow Point, and estimated to be worth $100,000, to be used and improved by the port commission for the purpose of encouraging and maintaining our marine commerce. The port commissioners have taken the initial steps to add to the land given the port by the State a tract of 20 acres, same being tide and shore lands, the present value of which is not less than $20,000.

The port commission employed the services of Virgil G. Bogue, who prepared a comprehensive set of maps and plans for the improvement to be made by the port commission, which were adopted by the people December 6, 1913. The plans as adopted contemplate the building of wharves and docks for the purpose of facilitating the loading of large vessels of deep draft, where cargoes could be assembled and rail and water connections made, thus eliminating the possibility of the vessel having to move from one dock to another to complete her cargo.

By levy on the taxable property of the port of Grays Harbor the commissioners have raised the sum of $116,000, all of which is in the hands of the treasurer, except about $5,000.

It has been the intention of the port commission to submit to the people of the district plans and specifications for the erection of docks and wharves upon the property owned by the port, called for the expenditure of at least $750,000 for this improvement, which will be raised by a bond issue covering the port commission's requirements.

Several of the leading bond houses of the United States have signified their willingness to accept the bonds of the port commission at par, at 5½ per cent interest, thus assuring the port commission of this amount of money for this purpose.

Unless the depth of water at the entrance to our harbor is deepened and a sufficient depth maintained to allow vessels of deep draft to enter our harbor with ease and safety, the port commission would not feel justified and warranted in the erection of docks and wharves and the expenditure of large sums of money on the improvements of this nature.

Respectfully submitted.

M. B. MAY,
FRANK H. LAMB,
H. M. DE LANTY,
Representing the Associated Commercial Bodies of Grays Harbor, Wash.

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

APPENDIX D.

STENOGRAPHIC NOTES TAKEN IN PUBLIC HEARING HELD IN COUNCIL CHAMBER, CITY HALL, ABERDEEN, WASH., JULY 16, 1914, RELATIVE TO IMPROVEMENT OF GRAYS HARBOR BAR.

The hearing was called to order by Lieut. Col. Edw, Burr, Corps of Engineers, at 3.18 p. m., and the following proceedings were had.

Col. BURR. Gentlemen, the board has been convened for the purpose of investigating certain questions in regard to the taking of further steps to secure the project depth of 24 feet on Grays Harbor Bar; in other words, with regard to taking further steps to continue this project for improvement of Grays Harbor to the project depth of 24 feet. The board has been directed to inquire with respect to several points, two of which are stated as larger cooperation by local interests, and worthiness of further improvement in view of probable expenditures involved. The board is here mainly for two purposes to-day, one of which is that all parties interested may have a full opportunity to express any views which they may have on the subject before the board. The meeting therefore is now open, and anyone who has any views to put forth on this subject is at liberty to do so.

Mr. W. B. MACK. Mr. President, we might state that we had a hearing before the board at Washington, and we submitted certain matters there, and it might be well to read that, unless the gentlemen here are all familiar with it, and then from that you could probably ask questions and we would be glad to answer. I would like to ask the board's idea on that.

Maj. CAVANAUGH. I think we are familiar with the arguments presented by local interests to the Board of Engineers for Rivers and Harbors which touches the matter of the value to the port of securing additional depth of water and the savings which may logically be expected from this increased depth. If the hearing could tend to support the arguments presented in your paper that will be presented to the Board of Engineers present—the pertinent matters—we should be glad to consider it.

Mr. MACK. Well, all right then. Well, we give in our report the actual exports for 1913, at permissible draft of 19 feet 6 inches, showing that in lumber we shipped 720,321 tons at a value of $5,320,596; slack cooperage, 3,210 tons, $107,000 value; fertilizer, 835 tons of $28,830 value; coal tar, 125 tons, $1,250; a total of 724,491 tons, value of $5,457,676. We also show that by rail during the same year we shipped in lumber 1,029,034 tons of a value of $6,055,418, and so on, a total tonnage of 1,075,288 tons, a value of $8,551,680 by rail. Now, our contention was, and is, that commerce, like water, seeks the course of least resistance; that this stuff moved largely by rail simply because the water transportation is not available; that all we could get in here was vessels with maximum draft of 19 feet 6 inches, the extreme limit, and that we could not make shipments that way to offshore points and other points, so that we were obliged to turn our attention to the rail market. During the year we shipped to various sections of the United States 416,290,763 feet of lumber, 425,892,125 shingles, 454,022 doors, etc.

Now, we may take up what we consider a conservative estimate with permissible draft of 24 feet, and we show an estimated yearly gain with 24 feet draft of $150,000 on lumber to the harbor. Now, I would like to say here that when we appeared before the committee in the House and the Senate in arguing on the repeal of the tolls question, that their estimate was $3 per thousand difference between coastwise lumber and lumber sold to foreign or offshore points. Our estimate was based on $2 a thousand, as we explained to the board. Lumber to the Atlantic coast, yearly gain of $700,000. Gain to vessel interests, $57,795.96. Salmon and clam pack, $22,646.20. Shingles, $180,000; reading on down the line, making a grand total of what we consider our yearly gain if shipped on a 24-foot draft of $1,201,867.16. I believe every one of those figures are conservative. Now on imports. A large proportion of our inbound shipments move by rail simply because our water facilities are so inadequate. Now, we believe that an estimated gain of 30 cents per 100 on imports or 25 per cent of inbound rail shipments would be conservative, amounting to $539,526 a year, making a total gain on imports and exports per year of $1,741,393.16. We estimate that the United States Government has in reserves over 35,062,500,000 feet. If that moves any other way than through a deepened waterway—by rail, it will cost the people of this Government $1.50 a thousand, or $52,593,750. Privately owned and State timber, 82,562,500,000 feet, at the same estimate amounts to $123,843,750. Loss to Government and State on timber not manufactured thus, 50,000,000,000 at $5 a thousand feet, $250,000,000. Now, those figures were made up by consultation with representatives of the forestry department. I made up a map and submitted it to the board and it is before them. If this timber should move any other way than through this harbor, it would cost a great deal more, approximately $5 a thousand. In other words, that if they should undertake to move this stuff over the Olympic Mountains to Puget Sound it would be very expensive. It would be very costly road construction, very expensive logging; that it would be working against nature, while coming down here it is a natural water route. These figures are really not ours; they are the forestry department figures, and we simply combined them in ours and make it a part of our argument before the board.

Mr. H. M. **Delanty.** Regarding the draft of water of 19 feet, of course, we all know there is a swell on that bar, and although we have 22 to 24 feet at high water, vessels drawing only 20 feet have struck. In the last case it cost the insurance close on $40,000, something they don't like very well. In that way the draft is limited. They don't want to send a steamer in here drawing over 19 feet 6 inches, and to get a steamer in here for a part cargo and go to Puget Sound to finish brings a great expense upon the ships. During 1913, we had 12 tramp steamers having a capacity of 32,800,000 feet, but they only took out 17,630,000, leaving 15,170,000 feet which they had to load elsewhere. Now, the differential in the rate, expense of shifting to other ports, at 75 cents a thousand (to make our figures conservative) leaves $13,222.50 actual expense to the ships where exporters sent their steamers here to take the limited cargo which the did. Pay roll at 85 cents a thousand is $12,894.50, which the longshoremen on Puget Sound were paid that should have come to this port; that is, if the steamers were sent here, and not counting the steamers that should have come here that were cancelled on account of the orders not coming here.

During the 13 months ending January 31, 1914, there were 71 vessels bar bound for 449 days. These vessels had a net tonnage of 50,461 tons, cargoes amounting to 69,585,000 feet of lumber. There were five foreign tramp steamers averaging 2,800 tons at $8 per ton, bar bound 12 days at $224. This is just the regular demurrage rate. In all cases of demurrage the demurrage is computed at the registered tonnage. They were bar bound 12 days, amounting to $2,688. That is not included in the $13,222.50 it cost them for shipping. That is outside of that entirely. Thirty-one foreign sail vessels averaging 616 tons at the same rate, bar bound 261 days at $49.28 per day, $12,862.08. Thirty domestic steamers, averaging 511 tons, bar bound. It cost them $14,700. Five domestic sailing vessels, cost $948.88, a grand total of $31,198.96 for last year's barbound.

The differential in rate; expense of shipping, $13,222.50; loss of pay roll, $12,894.50; loss and expense to bar-bound vessels, $31,198.96; and the item of interest on investment, $490 making a grand total of $57,795.96 lost to the shipping of this port—the people of this port.

In many cases we could get a large vessel in here for cargo, but all we can load is 19 feet 6 inches. The pilots don't dare take her out, unless on a very smooth day, but it may be 30 days, or 3 or 4 months, before the water is smooth enough to carry a deeper draft. For that reason exporters don't want to leave their vessels in here for an uncertain period, when they can get a full load on Puget Sound or the Columbia River. Therefore it is keeping us out of the Australian and other foreign markets. They will not send their vessels in here for a fraction of a cargo, because the manufacturers here can not assume this differential. Local managers of steamship companies have told me that they would not send any more steamers here unless this differential were removed, and every one of these steamers leaves a pay roll of say $3,000. That is, there is that much money lost to this harbor, with loss of the trade.

Mr. F. H. LAMB. Mr. Chairman, I take it that the fact has been established that there is a differential against this harbor in so far as the shipment of lumber is concerned. As to the exact amount of this differential, there might be some difference of opinion, but that it exists I can not conceive that there should be any. The fact that we have only loaded about half of the tramp steamers which came in would seem to establish that. Now, the loss to this harbor that would entail upon the basis of the business which we did last year is a thing that can be definitely and positively determined. As to the balance of the timber tributary to the harbor, that also is a definite question, as we have the figures of the Government foresters which show that there is approximately 94 billion feet of timber which will ultimately come to this harbor. There is another fact which I want to present to the board, and that I do not think has been dilated upon enough, and that is that as a lumber-shipping community, with the opening of the Panama Canal, the markets which we have been reaching in the East and the Middle West, instead of being tributary to us by rail at a rate of say from $20 to $25 per 1,000, will become tributary to the west coast by water at a rate not exceeding a half of that. Therefore we must so adjust our affairs as to be in a position to enter that business and compete with other localities. Only vessels of limited draft can enter our harbor at the present time, and unless we can see some change, some improvement, I can not conceive but what we are going to be at a disadvantage under this change in conditions which I have stated.

Now, it might be argued that we are in the same condition as a great many other localities, and that the General Government should fix all localities so that they can compete on equal terms. When we consider the magnitude of the timber interests of this section, this is the largest body of timber tributary to any one port in the United States, being nearly 100 billion feet. I don't think the board should look at this matter simply upon the basis of what we have done in the past. We realize that our shipments have not been as large as we would like to see them, particularly by water, but this has been caused largely by the conditions here, and also because we are advantageously situated as regards rail facilities, but we feel that in the future the necessity for emphasizing water shipments will be so great we can not neglect looking after our harbor and getting the maximum out of it that is possible. As regards the remark of Mr. Mack in regard to freight matters, I should much prefer to have the board indicate what they wish to ask along that line, but I want you to base your conclusions on our arguments, not alone upon what we have done on the past but what we expect to do in the future. We are a young and growing community, and we are here to stay, as you can see by our cities and towns, which are of recent growth, and we expect to be here for a number of years, and we believe any increase in population and any increase in material wealth accruing to the people of this section from and in consequence of the lumber tributary to Grays Harbor is an advantage to the United States, and that advantage will not come to us alone but will be distributed to the consumer. The fact that the market is widened, or that the area of production is widened, certainly affords a larger supply, and a larger supply affords lower prices to consumers in all cases, so it should be looked at from a standpoint not only of this locality, but so far as we are able to effect the whole Nation, from the standpoint of the ultimate good of the entire lumber-purchasing public.

Mr. MACK. I would like to call your attention to this letter which has been received by citizens of this harbor:

"We, the undersigned, are heavily interested in the exporting of lumber to all parts of the world. The quality of the lumber and the facilities of getting the same at the different mills in Grays Harbor are second to none. The steamers we use in the lumber trade are tramp steamers, say from 2,800,000 to 3,750,000 feet capacity, therefore, with reference to the proposed action of the United States Government in discontinuing the work on the north jetty at Grays Harbor, Wash., we would advise you that in this event we would refuse to send our large tramp steamers to your port as we have done in the past. At the present time our large steamers can only take out part cargo from Grays Harbor, going to other ports in the Northwest to complete, thereby causing us an additional expense for extra freight and cost of shifting. This we have been doing in order to hold certain trade and the hopes that with the proper extension of the north jetty the channel over the Grays Harbor Bar would be of such depth as to permit of these steamers carrying full cargoes to sea, as from the ports on Puget Sound or Columbia River. The channel over Grays Harbor Bar has been gradually deepening, owing to the effect of the present jetties, but with the stoppage of all work, this gain will not only be lost, but, in our opinion the channel will most certainly shoal, and in anticipation of this we contemplate discontinuing our steamer service to Grays Harbor for outward cargoes."

This is signed by Comyn, Mackall & Co., Balfour, Guthrie & Co., W. R. Grace & Co., Robert Dollar Co. and American Trading Co., A. F. Thane & Co., J. J. Moore & Co., Hind Rolph & Co., and G. W. McNear (Inc.).

Gentlemen, the signers of this letter are exporters that have been trading along this Pacific coast, and we can not hope for further steamers in here until we have improved that bar. Now, it is the opinion of navigators using the channel across that bar that the maximum effect of that jetty has been felt. We believe that the channel will break to the south, as it has in the past, and that we will have good water temporarily, and that she will gradually shift to the north again as she has in the past. The channel is pretty well to the north now, and the channel is bad; that is all. There is no use in disguising the fact that it is the worst kind of a bar, and it is going to be so until that jetty is extended. It has been suggested that it would be better to go in and try a system of dredging and try that out, but we do not believe that would give a permanent channel. We are mighty skeptical of that in Grays Harbor. We are not engineers, but we are quite skeptical of what a dredge will do, for the sand is shifting and would not hold a channel.

MEMBER OF BOARD. Mr. Mack, may I ask a question? You say that these tramp steamers carry from 1¾ to 3¾ million, roughly. What would be the draft of these vessels?

Mr. MACK. Well, it varies. Now, take a vessel with capacity of 2¼ million and she would draw about 20 feet 4 inches.

Col. BURR. Now, those boats you mentioned to carry lumber will probably not go over 21 feet?

Mr. MACK. 21 feet 6 inches to 22 feet. So that with 24 feet of water here we can handle any vessel engaged in lumber shipment on the Pacific coast. We could not handle the *Minnesota* or anything like that, but we could handle anything that will be engaged in the Panama Canal trade or on the Pacific coast.

If there are any questions, we would be glad to answer.

Before the board we submitted a chart that showed the shifting of the channel. Have you got a copy? Are there any charts here that would show that?

Maj. CAVANAUGH. We have access to them, Mr. Mack, in the Seattle office.

Mr. MACK. Well, these were made up by navigators who are operating on the bar, and we thought that you did not have access to them.

Maj. CAVANAUGH. Perhaps we have not seen these particular ones, but we have a chart in the office at Seattle which indicates the different positions which the channel has occupied for perhaps the last 15 years.

Mr. MACK. The chart indicates how the channel across the bar breaks to the southward, and then to the northward again.

Col. BURR. I think we understand it.

Mr. MACK. Then there is no use dilating upon that.

Maj. CAVANAUGH. Can you give us any information, Mr. Mack, as to the insurance rates actually paid on traffic under present conditions here as compared with Puget Sound and the Columbia River?

Mr. **Mack.** There is no difference, but we are working overtime to keep it that way.

Maj. **Cavanaugh.** Then, as yet there has been no differential as against Grays Harbor in the matter of insurance?

Mr. **Mack.** No, sir. They are the same.

Maj. **Cavanaugh.** Will you give us an idea as to the actual amount of insurance on 1,000 feet of lumber? Of course, that varies with the grade of lumber.

Mr. **Mack.** I could not. It varies with the price of lumber. I would say 6 cents a thousand. Cost for insurance is not heavy, but if they raise it shippers will say "Here is a harbor that is no good and we will not trade there." So it isn't the cost as much as the bad reputation.

Col. **Burr.** That insurance is on the lumber as well as the vessel if she comes in here?

Mr. **Mack.** Yes, sir.

Member of Board. I would like to ask what are your port charges?

Mr. **Mack.** I have not got the information here. I could send it to you.

Mr. F. H. **Lamb.** There are no port charges; no dock charges or anything beyond the regular Federal charges such as customs, the tonnage tax, etc. There are no charges of any kind, not even pilotage. If a master is familiar with the harbor, he comes in and out himself and does not pay a cent. If he feels that he needs a pilot, he engages a local pilot or an outside man, and they arrange the price to suit themselves. It is an absolutely free port.

Col. **Burr.** There are no public docks?

Mr. **Lamb.** Well, there is a city dock at Hoquiam. The port commission are building a dock between Aberdeen and Hoquiam.

Col. **Burr.** I would like to ask you to tell us something further about what the port commission has in view, particularly as to the question of larger cooperation by local interests in this harbor.

Mr. **Mack.** In line with cooperation you have been over our harbor, and you see its condition. We have done a lot of work in the inner harbor. We are not asking the General Government for a cent for that. All we are asking is that they make the outer harbor, and the gentlemen will tell you, I think, that they have quite ambitious plans for improving the inner harbor, and they don't expect any help from the Government. We think we can carry that through, and that is all we are going to try to do. It is going to take all the money which this district can raise to do that, and I don't think it would be a good business proposition for this district to attempt to work with the Government in doing any outside work. If they did they would simply have to neglect the inner work, and at the time that you had good water there there would be no facilities. Now, if the Government will attend to the outside work—in other words, complete the project which they started—and let us work out our inner harbor, we would have public docks that for facilities would equal any; limited, of course, but equal to any on the coast, we think. I would like to have Mr. Lamb or Mr. Patterson talk on that and explain what we are going to do.

Mr. **Patterson.** I hope that my statements will not be taken doubtfully. To you it may seem that our statements here are ridiculous and absurd, but to the people who live here and who know, it is an entirely different matter. I appreciate to-day more than ever the fact that we are not prepared to submit to you sworn statements of these matters. We feel that we have a harbor of sufficient importance that would warrant the United States Government taking up this work. I believe Capt. Dillon brought up the question of the difference between the amount of lumber shipped from Grays Harbor and the amount of lumber shipped from Coos Bay. From the information that I have been able to get hurriedly, I am inclined to believe that your statement that they ship nearly as much as we do is more or less correct. However, I want to emphasize this fact, that they ship their output by water, while we ship only a part by water, due to the fact that we can not. We ask for this improvement because of the fact that we are prepared to state that our shipments will be by water just as soon as we are in position to be competitors in the eastern market. Now, along this line I would say that the people of this harbor practically subscribed to pay an improvement of $150,000 a year in order to get a line of steamers to run from here to New York. Now, we could not afford to take this step unless we thought that the Government was going to proceed with the bar. I presume you are familiar with the documents submitted to the Board of Engineers. We are prepared to stand upon the facts as stated in these documents. Now, we find a great deal more that we did not touch upon directly in these documents.

There are the imports into this harbor, which we are now forced to bring by rail at a higher expense. As to the matter of the port commission's plans, I believe this commission went on record before Maj. Cavanaugh at a meeting some time ago as being willing to cooperate with the development in everything that we could. I believe that he asked us at that time to assist in the maintenance of the jetty, and I think we agreed to do that pending the action of Congress.

Col. Burr. One question, please. What are the present resources of the port commission?

Mr. Patterson. At present I think we have on hand $110,000.

Member of Board. What are the geographical limits of the port?

Mr. Patterson. Chehalis County.

Member of Board. How was that money raised?

Mr. Patterson. By direct taxation; by direct levy on all the property of the county.

Member of Board. Mr. Patterson, is this a distributing point of merchandise to any considerable territory?

Mr. Patterson. I am very glad you asked that question. We are not distributing at all, due to the fact that we have this bar to contend with.

Mr. Polson. Mr. Chairman, gentlemen, I think we should be congratulated that the Government has taken interest enough in our harbor to send their engineers down here with our own Maj. Cavanaugh and to look over the harbor and bar. Now, while they are here to ask questions, I suppose they are not averse to being asked questions. I would like to ask this one question, and that is—they are here to find out if we are really worth the expense of giving us a 24-foot channel to the sea. I think I could almost answer that, that they are. Well, some of them are from Maine; I actually believe honestly they are from Missouri, and I am not going to try to prove any of Mr. Patterson's stories; but they have done me the kindness to stop over a few hours tomorrow and I am going to prove to those gentlemen that we have the resources as far as the timber is concerned, and if I can keep them here one week I could prove to them that we have the resources as far as agriculture is concerned, to say nothing of the fisheries, and when they leave here they would not any of them be from Missouri, they would all be from Maine. I appreciate more than I can tell them their coming to the harbor here. The Olympic Forest Reserve, the greater portion of that is not fit for agricultural purposes, and will reforest and reforest itself without expense to the Government, except the expense of keeping out fires and keeping it from burning. That timber is accessible to Grays Harbor. Our forest reserve is estimated at about 40 billion. If it was cut off and marketed in the East it would be worth a great deal more, but we have no market for it; our transportation is too high. We are burning lumber in our fires, better lumber than they are paying $35 a thousand for on the Atlantic coast, and, according to the best figures I could get, in the city of New York last year, just for building purposes, they have used 3 billion feet. A great portion of that came from Canada. Every dollar that goes into Canada is a dollar taken from the American pocket. I hope our engineers will so recommend to our Government, which was kind enough to send them out here, for their interest as well as our own, to improve this harbor to 24 feet, which will save millions and millions of dollars in timber. There is 5 billion feet, we estimate, growing on the Quinault Forest Reserve. If the Government sees fit to sell that timber there would be a saving in transportation if we have deep water over the bar.

I believe that this board of engineers are here to see if we have the resources in the country to justify the Government in spending the money, which is a mere bagatelle in considering the Nation's interest alone, which belongs not to the State of Washington entirely, but to every citizen in the United States, to give us what we are asking for—24 feet of water.

Col. Burr. Anybody else wishes to be heard? If no one else wishes to be heard the hearing is closed.

(Hearing adjourned at 4.30 p. m.)

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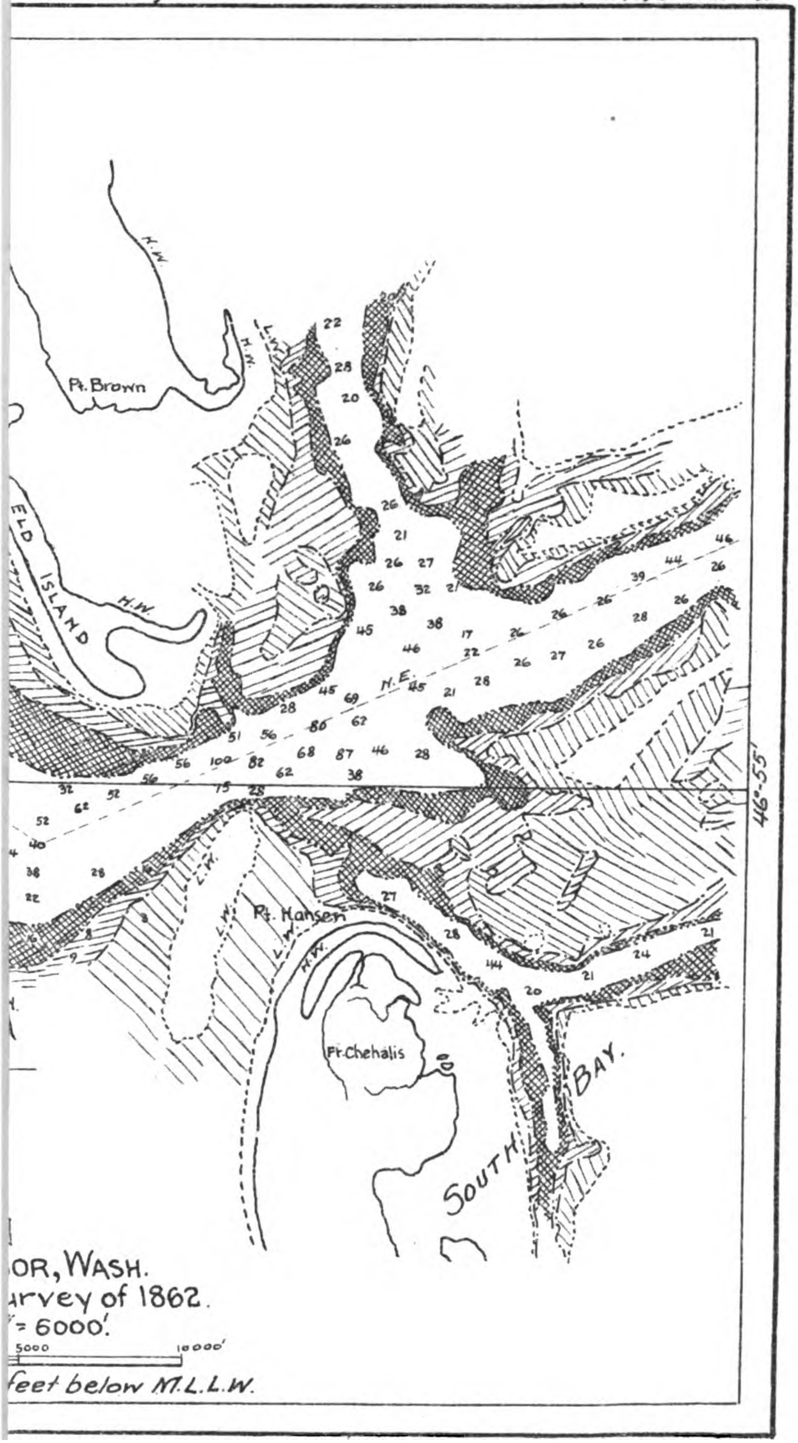
DEC. 24, 1913. CORPS OF ENGINEERS, U.S. ARMY.



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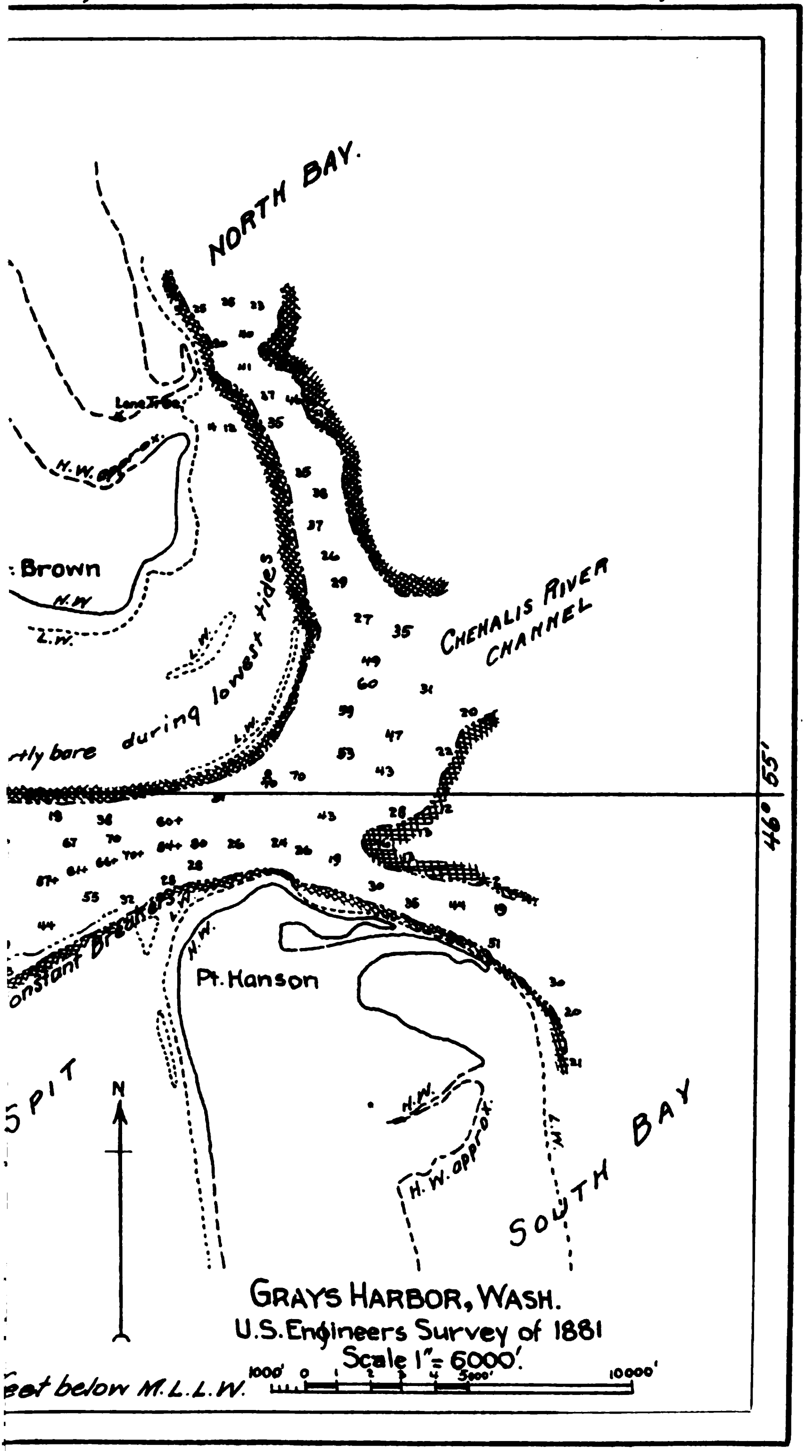

GRAYS HARBOR, WASH.
U.S. Engineers Survey of 1881
Scale 1" = 6000'.

House Doc. No. ; 64th Cong., 2d Sess.

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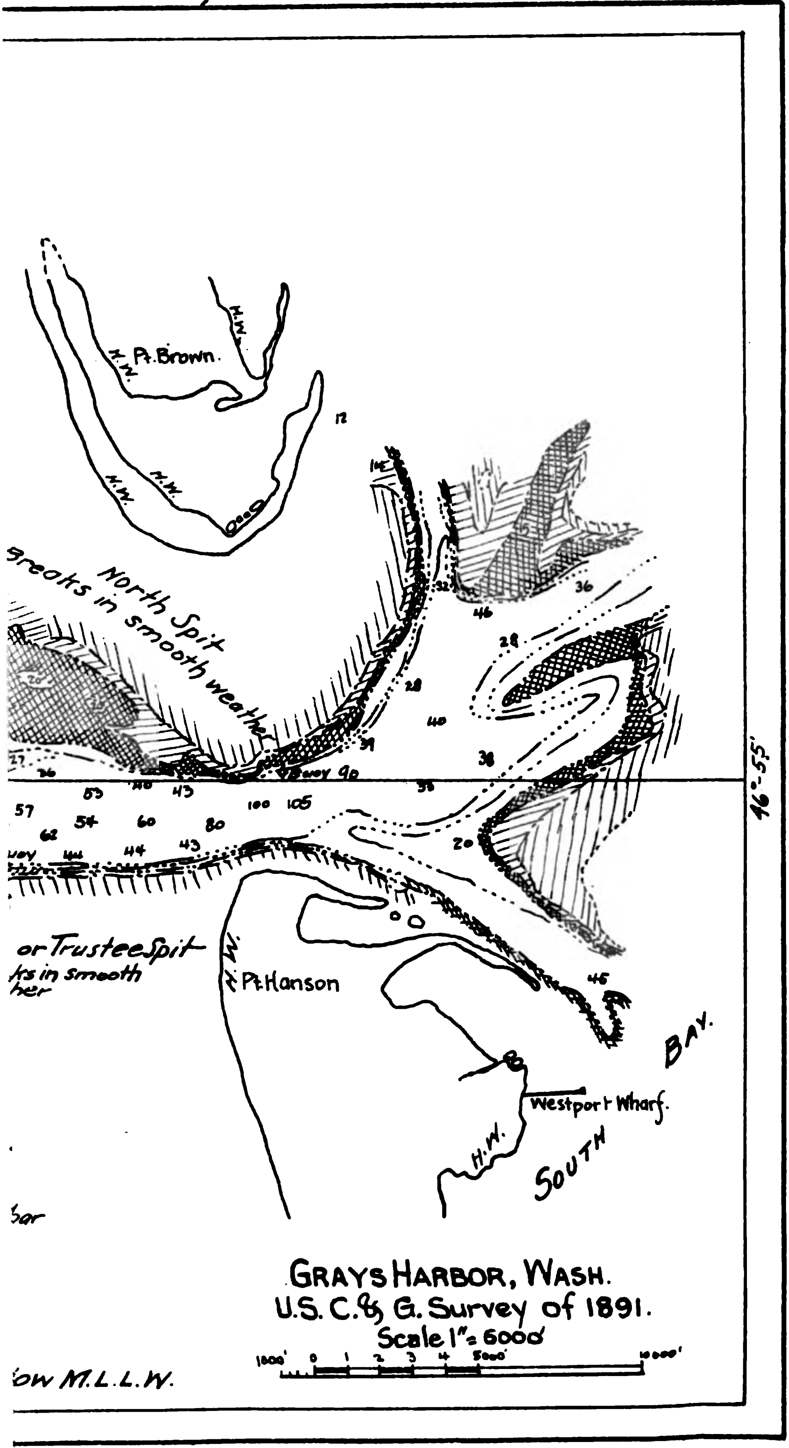
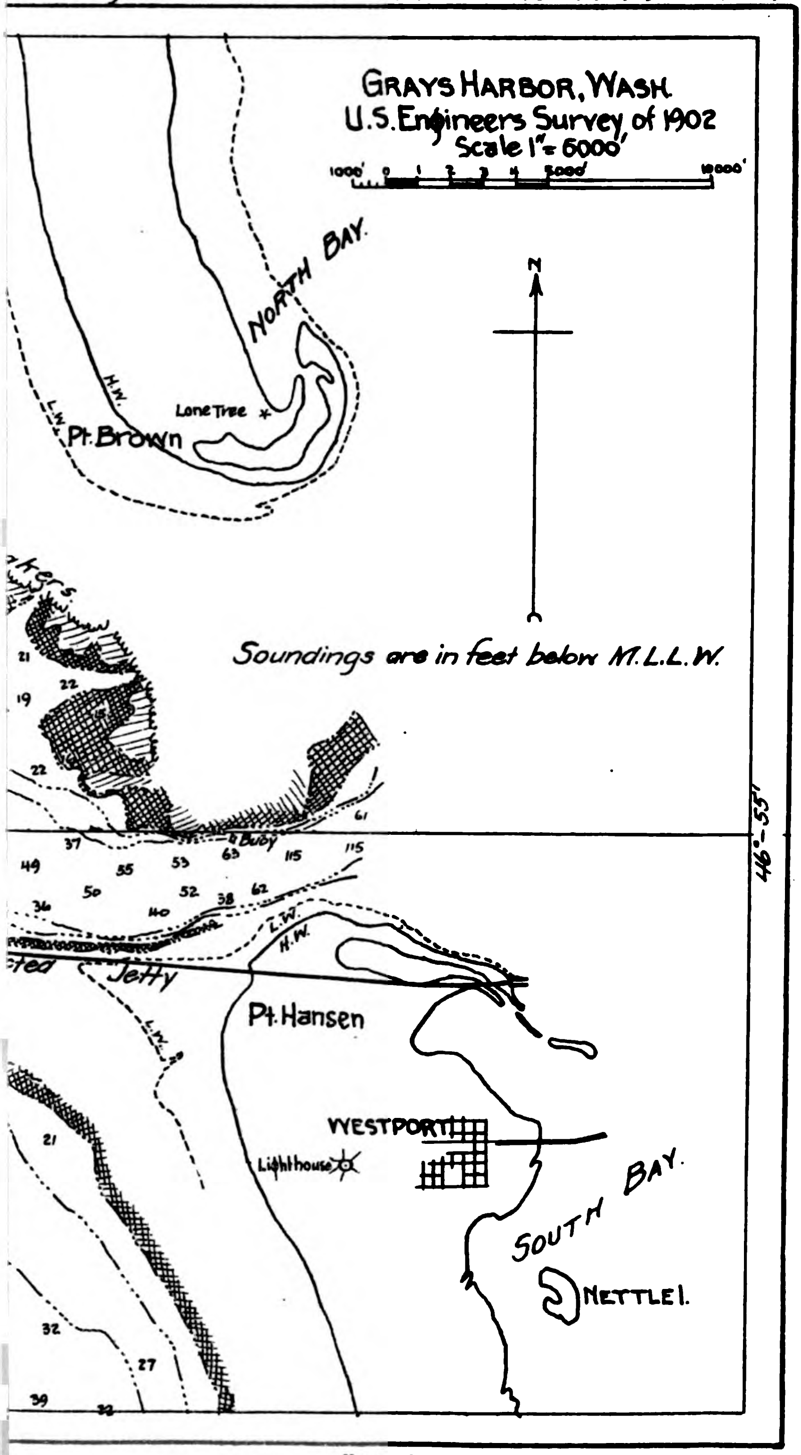


GRAYS HARBOR, WASH.
U.S. C.& G. Survey of 1891.
Scale 1" = 6000'


GRAYS HARBOR, WASH.
U.S. Engineers Survey of 1902
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Jetty
Pt. Hansen
L.W.
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WESTPORT
Lighthouse
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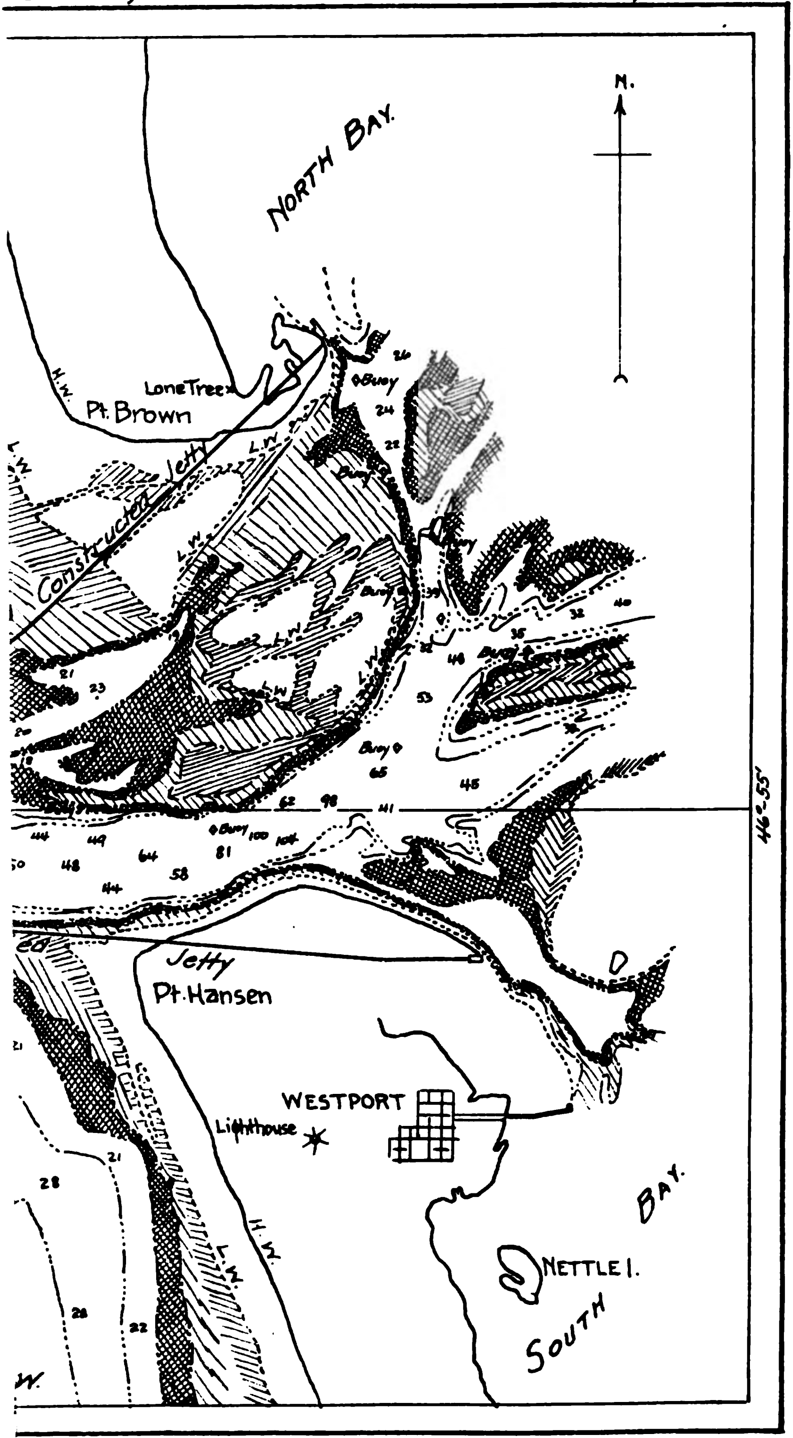
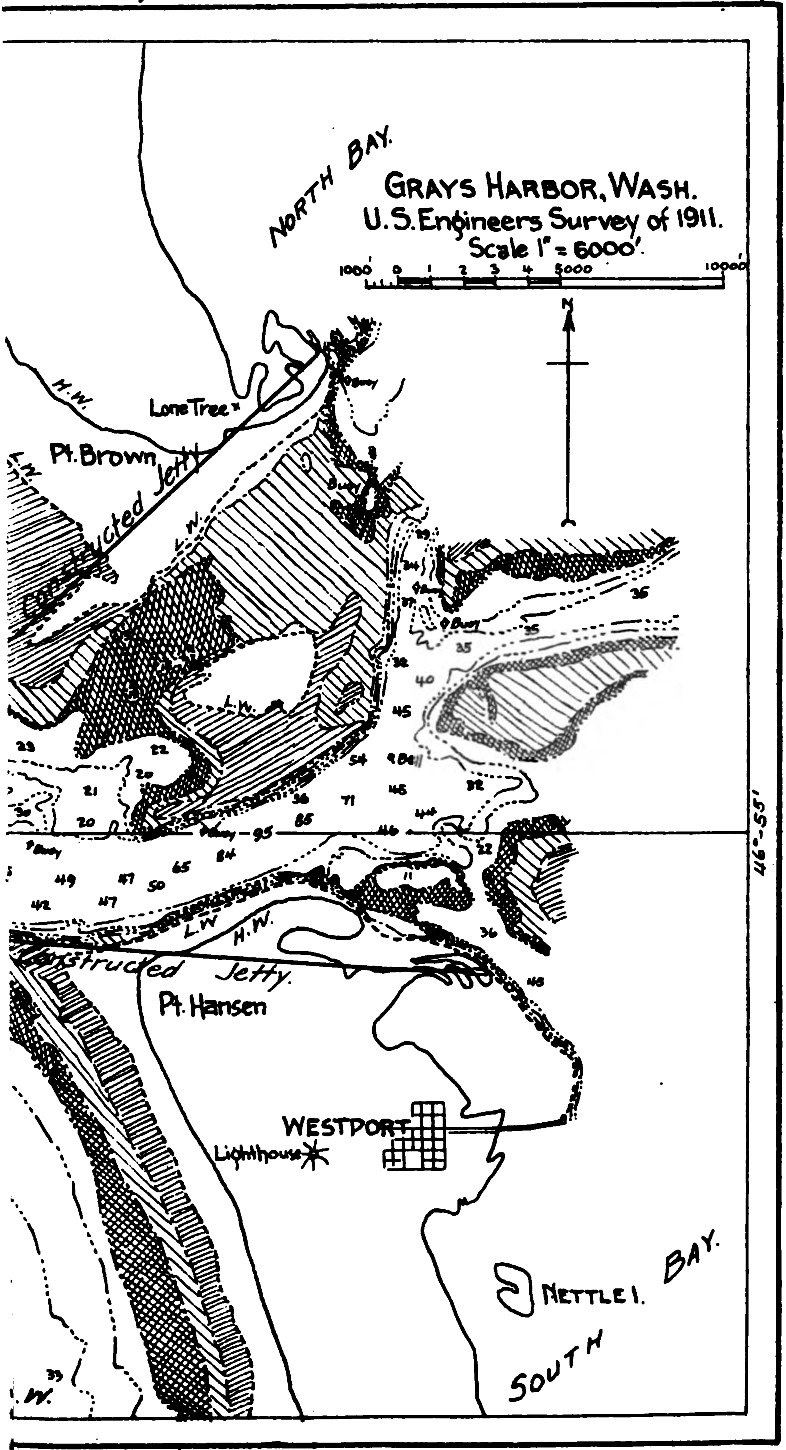
DEC. 24, 1913. CORPS OF ENGINEERS, U.S. ARMY.

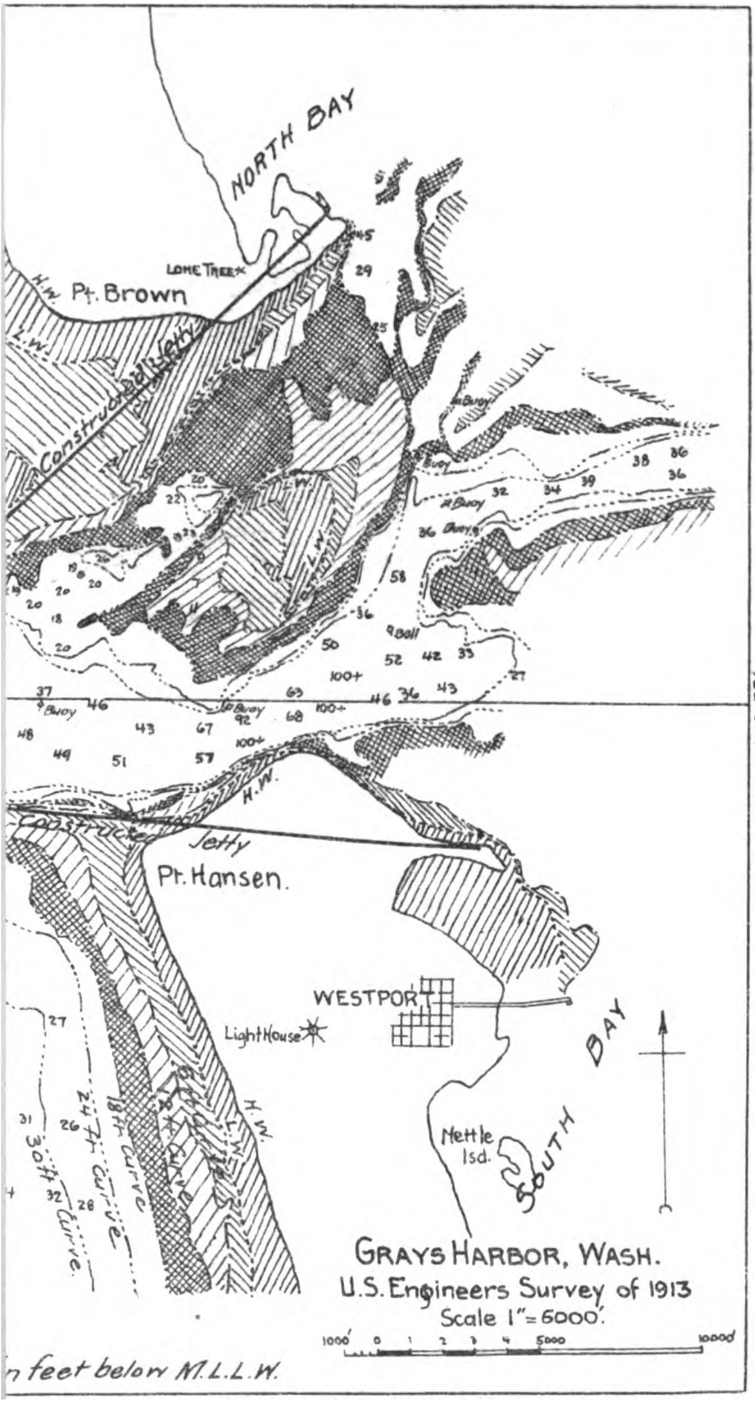


Dec. 24, 1913. Corps of Engineers, U.S. Army.

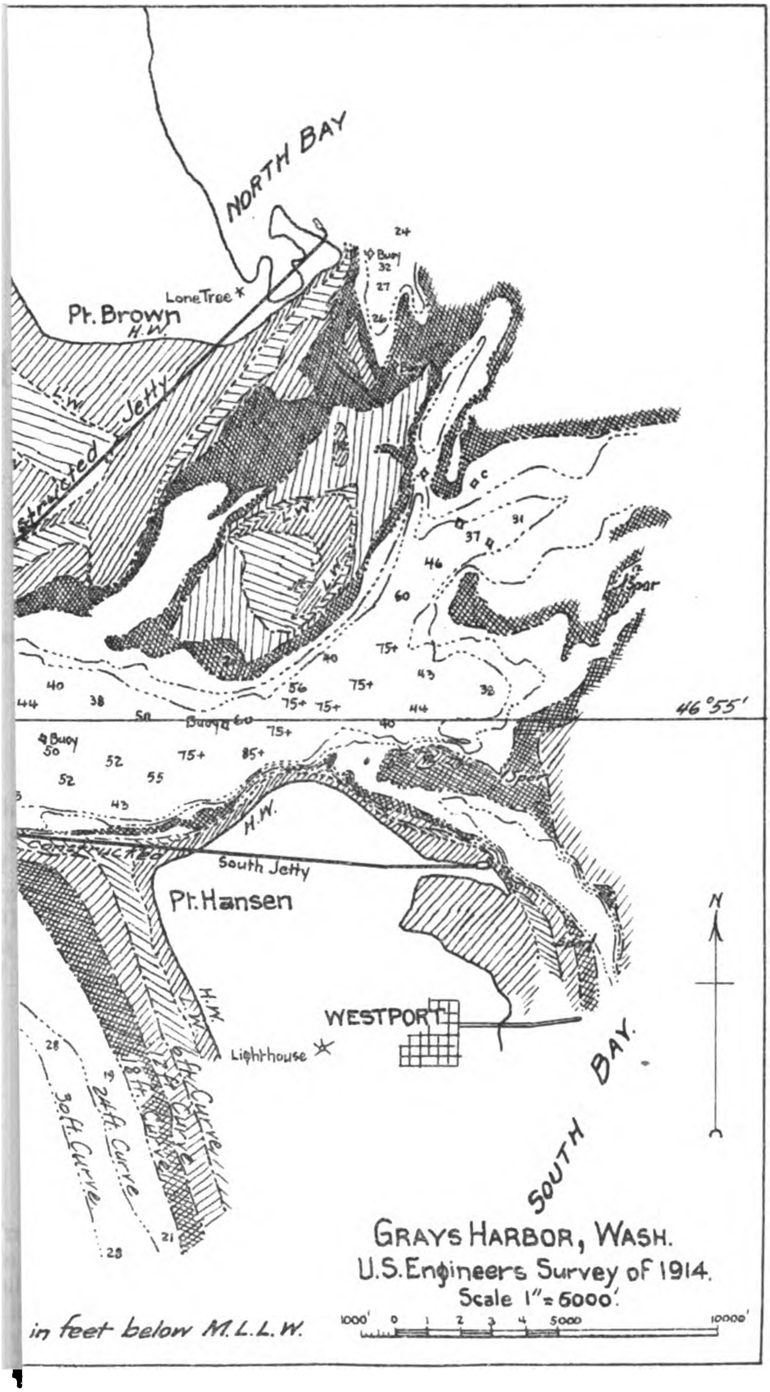


House Doc. No. ; 64th Cong., 2d Sess.

DEC. 24, 1913. CORPS OF ENGINEERS, U.S. ARMY



GRAYS HARBOR, WASH.
U.S. Engineers Survey of 1913
Scale 1"=6000'.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WESTPORT
Lighthouse
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18 ft.
30 ft. Curve
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12 ft. Curve
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21
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SOUTH BAY
46°55'
GRAYS HARBOR, WASH.
U.S. Engineers Survey of 1914.
Scale 1" = 6000'.
in feet below M.L.L.W.
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64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1730.

CHICKASAHAY RIVER, MISS.

LETTER

FROM

THE SECRETARY OF WAR.

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION OF CHICKASAHAY RIVER, MISS., FROM ITS MOUTH TO SHUBUTA.

DECEMBER 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

WAR DEPARTMENT,
Washington, December 11, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, dated the 6th ultimo, together with copy of a report from Lieut. Col. C. Keller, Corps of Engineers, dated December 3, 1915, on a preliminary examination of Chickasahay River, Miss., from its mouth to Shubuta, made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

WM. M. INGRAHAM,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, November 6, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination of Chickasahay River, Miss., from its mouth to Shubuta.

1. There is submitted herewith for transmission to Congress report dated December 3, 1915, by Lieut. Col. C. Keller, Corps of Engineers, on preliminary examination authorized by the river and harbor act

approved March 4, 1915, of Chickasahay River, Miss., from its mouth to Shubuta.

2. The Chickasahay River is formed by the confluence of Chunky and Okatibbee Creeks, and joins the Leaf River 205 miles below to form the Pascagoula River. Shubuta is 130 miles above the mouth of the Chickasahay. The existing project, adopted by the river and harbor act of March 3, 1905, provides for the maintenance, by snagging, of a channel for high-stage navigation from Bucatunna to the mouth, a distance of 75 miles, at an estimated annual cost of $2,500. The expenditures on all projects to June 30, 1915, amounted to $25,250. Practically the whole section of river under consideration is badly obstructed by logs, snags, overhanging trees, shoals, etc. The traffic on the river is almost entirely confined to the floating of logs and other timber products, which is carried on at high water, and for which improvement is not required. In view of the small and decreasing commerce on the river and the evident lack of need for its improvement at the present time, the district officer is of opinion that the further expenditure of public funds at this time for the improvement or maintenance of this locality is not justified. The division engineer concurs in this opinion.

3. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 11, 1916, concurring in the views of the district officer and the division engineer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Chickasahay River, Miss., from its mouth to Shubuta, is not deemed advisable at the present time, and legislation is recommended authorizing the abandonment of the existing project.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 11, 1916.

The Chief of Engineers, United States Army:

1. The following is in review of the district officer's report authorized by the river and harbor act of March 4, 1915, on preliminary examination of Chickasahay River, Miss., from its mouth to Shubuta.

2. The Chickasahay is formed by the confluence of Chunky and Okatibbee Creeks at Enterprise, 205 miles above the mouth of the river. The distance by water from the mouth to Shubuta is 130 miles. The uplands of the Chickasahay basin were originally covered with timber, largely pine, most of which has been removed. The lowlands still have a considerable supply of hardwood, difficult to get out because of dense undergrowth and lack of buoyancy for rafting.

3. The existing project, adopted by the river and harbor act of March 3, 1905, provides for the maintenance, by snagging, of a channel for high-stage navigation, at an estimated annual cost of

$2,500. Under this project there had been expended to June 30, 1915, $12,850.27, and on all projects, $25,250.

4. Practically the entire section of river under consideration is badly obstructed by logs, snags, overhanging trees, and other obstructions. In the first 40 miles below Shubuta the river is closed to navigation, even on a rise of 6 feet by the presence of 14 fish traps or dams. The river is crooked and there are many sharp bends. Between Shubuta and the mouth there are 121 shoals, having a depth of less than 3 feet, the controlling depth on many of them being about 1 foot and width about 30 feet. Of these shoals 13 are of soft rock. Apparently not more than about 10 per cent of the contiguous territory is under cultivation. Practically the only business on the river is the floating of logs and other timber products, which is carried on at high water and does not require improvement. In view of the small and decreasing commerce and the lack of need for improvement, the district officer reports that further expenditures for improvement or maintenance are not justified. The division engineer concurs.

5. Interested parties were informed of the unfavorable report of the district officer and given an opportunity of submitting statements and arguments to the board, but no communications on the subject have been received.

6. This is a small, crooked, and much obstructed stream, navigable only at high stages. There is no commerce except floated timber products which do not require improvement, and there is no prospect of any in the near future. Expenditures under these conditions, either for original work or for maintenance, do not give adequate returns. The board therefore concurs in the views of the district officer and the division engineer and reports that in its opinion it is not advisable for the United States to undertake any additional improvement of the Chickasahay River or to continue work under the existing project, and it recommends legislation authorizing the abandonment of the improvement.

7. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other related subjects which could be coordinated with the suggested improvement in such manner as to render the work advisable in the interests of commerce and navigation.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF CHICKASAHAY RIVER, MISS.

United States Engineer Office,
Mobile, Ala., December 3, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army.
(Through the Division Engineer).
Subject: Preliminary examination of Chickasahay River from its mouth to Shubuta.

1. In department letter of March 15, 1915, it was directed that there be made an examination of the Chickasahay River, Miss.,

authority for which is found in section 15 of river and harbor act approved March 4, 1915, which reads in part as follows:

> SEC. 15. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities * * * Chickasahay River, Miss., from its mouth to Shubuta * * *.

2. The report on this examination now follows:

Geographical features.—The Pascagoula River Basin is in the southeastern part of Mississippi, and drains that part of the State lying to the east of the Pearl River Basin and to the south of the Tombigbee Basin. The area of Pascagoula Basin is about 8,750 square miles.

3. In its original condition the upland was heavily covered with long-leaf pine, and the stream valleys with a mixed growth containing oak, cypress, sycamore, gum, etc., some of it suitable for fence posts, crossties, and saw logs.

4. Most of the pine has been cut away. What remains is at places not readily accessible to the waterways except by the small creeks, and these can be used only at times of protracted rains. The log roads have now physical connection with the Mobile & Ohio Railroad. Oxen are still used to a certain extent to draw logs to the stream banks, but as the distance from standing trees to the waterways increases this method of transportation will gradually fall into disuse.

5. In general the soil of the cut-over lands is too light for successful farming without the use of fertilizer. As elsewhere, the bottom lands are fertile and if divested of the trees and undergrowth would yield good crops.

6. The Pascagoula River is formed by the confluence of the Leaf and Chickasahay at Merrill (88.9 miles by water above its mouth).

7. The Chickasahay is formed by the confluence of Chunky and Okatibbee Creeks at Enterprise (205 miles by water above its mouth). As it flows south to Merrill it drains the easterly tier of counties of Mississippi from Kemper County to George County. The distances by water from the mouth at Merrill to the more important towns along the Chickasahay are as follows: To Bucatunna, 75 miles; to Shubuta, 130 miles; to Enterprise, 205 miles. The locality under consideration is that portion of the river between the mouth of the Chickasahay and Shubuta.

8. The Chickasahay receives its principal tributaries below Enterprise, as follows: Hassanlowaha Creek, at Quitman (mile 175 above Merrill); Eucutta Creek, about 4 miles below Shubuta (mile 126 above Merrill); Bucatunna Creek, about 2 miles below Bucatunna (mile 73 above Merrill); and Big Creek (in Greene County), about 18 miles below Leakesville (mile 14 above Merrill). In the absence of a survey the distances stated are only approximate.

9. The total area of the drainage basin of the Chickasahay is about 3,170 square miles, of which an area of 2,200 square miles is below Enterprise, and 1,770 square miles is below Shubuta.

The uplands of the Chickasahay Basin, like those of the rest of the Pascagoula Basin, are, as stated, for the most part, cut-over pine land. Some tracts of pine still remain, but with the exception of a very few isolated tracts, two years of active logging will probably complete the denudation of the Chickasahay Valley of its better pine.

In the vicinity of Lucedale some careful farming and fruit raising is being carried on. The expense of clearing the ground of the pine stumps and the cost of commercial fertilizer are both so great that farming of the pine lands has as yet made little progress. The "hardwood" or mixed growth found in the stream valleys has not yet been disposed of because of the lack of demand, difficulty of getting it out of the dense undergrowth, and lack of buoyancy of the hardwood logs and ties.

10. *Previous reports on the Chickasahay River.*—A report on an examination of the Chickasahay River from Shubuta, Miss., on the Mobile & Ohio Railroad, in Clarke County, to its mouth at the head of the Pascagoula River, a distance of 130 miles, was submitted February 6, 1879. (Annual Report, Chief of Engineers, 1879, p. 841.) The river was stated to be susceptible of improvement at an estimated cost of $11,500. No work was done under this project.

11. The report of an examination from Enterprise to Bucatunna was submitted February 16, 1889. (Annual Report, Chief of Engineers, 1889, p. 1463.) The cost of improvement from Enterprise to the mouth was estimated at over $100,000, and from Shubuta to the mouth at $30,000, and the annual cost of maintenance at $5,000. Upon this examination the original project of September 19, 1890, was based.

12. The project of September 19, 1890, provided for high-stage navigation from the railroad bridge at Shubuta to the mouth (Annual Report, Chief of Engineers, 1891, p. 1791); this was modified in act of June 3, 1896, by limiting the improvement to the section of 75 miles between Bucatunna and the mouth.

13. The river and harbor act of June 13, 1902, combined the existing projects for the improvement of Pascagoula, Chickasahay, and Leaf Rivers into one work of improvement. (Annual Report, Chief of Engineers, 1903, p. 1260.)

14. The existing project is based on the report submitted June 9, 1903 (Annual Report, Chief of Engineers, 1904, p. 1854; H. Doc. No. 230, 58th Cong., 2d sess.), on an examination of the river from Bucatunna to the mouth. This project provides for the maintenance, by snagging, of a channel for high-stage navigation at an estimated annual cost of $2,500. It was adopted in the river and harbor act of March 3, 1905.

15. *Previous improvements.*—The work of improvement under the original project was begun October 31, 1891, and by June 30, 1896, the river from its mouth to Waynesboro (85 miles) had been cleared of obstructions. The cost of the work was $12,070.90 for improvement and $328.83 for maintenance. A high stage channel was provided, which had a minimum width of about 80 feet, and a depth believed to be sufficient for small steamboats at a stage of 4 feet. No work was done above Waynesboro. No steamboats used the improved section at that time.

16. Under the project as modified in 1896, work was carried on between the mouth and Bucatunna (75 miles). By June 30, 1905, a high-stage channel from the mouth to Bucatunna had been provided by the removal of snags and overhanging trees. Notwithstanding the work done, the stream deteriorated somewhat, but on June 30, 1905, rafting was still possible on a slight rise. Up to this date the work

carried on under the modified project had cost $9,350.27; the total cost since the adoption of the original project amounted to $21,750.

17. Under the existing project, based on the report printed in the Annual Report Chief of Engineers, 1904, page 1855, providing, by snagging and removal of obstructions, for the maintenance, from Bucatunna to the mouth, of a channel to permit rafting at high stage, no work was done except during the fiscal year 1908. On June 30, 1908, the condition of the Chickashay was such that on a rise of 6 or 8 feet a waterway for rafts and flatboats was available from Shubuta to the mouth. The cost of maintenance work during the fiscal year ending June 30, 1908, amounted to $3,127.46. The commercial value of this stream was judged to be unimportant, and the expenditures were kept as low as was permissible. From June 30, 1908, to June 30, 1915, the expenditures for maintenance amounted to $372.54. This was spent for the upkeep and repair of plant. No work was done on the river.

18. *Present examination.*—On June 18, 1915, the district engineer officer sent out circular letters to all regarded as probable sources of information requesting commercial statistics showing the present and prospective use of the stream. Between July 28, 1915, and August 3, 1915, the river from the steel highway bridge at Shubuta, Miss., to its mouth at Merrill, a distance of approximately 133 miles, was examined by Junior Engineer Nester. The entire section was covered by working downstream in a small skiff. The banks were examined, soundings of the channel were made, and obstructions to navigation were noted. Wherever there was an indication that information of the present and prospective use of the stream could be obtained, an effort was made to collect commercial statistics, and photographs of the bridges and more important obstructions were taken. The photographs[1] are attached to this report.

19. On July 28, 1915, the gauge reading at Shubuta was —0.9, or 1.78 feet below mean low water. On August 3, 1915, the gauge reading at the New Orleans, Mobile & Chicago Railroad bridge, 0.2 mile below the mouth of the Chickasahay, was —0.1, or 1.1 feet below mean low water. In this report all depths are referred to mean low water.

20. Practically the entire section of river under examination is badly obstructed by logs, snags, stumps, fish traps, shoals, and overhanging trees. Except on the numerous shoals and bars, the current at this low stage was not perceptable. Between the steel highway bridge at Shubuta and the lower steel highway bridge at Waynesboro, 40 miles below, the river, even on a rise of 6 feet, is closed to navigation by 14 fish traps. These traps are made of a double row of piles filled with brush and rock, and in many cases they are sheathed on the upper side. They are thus practically dams. These traps have raised the river surface several feet, and made it difficult to determine what would be the depths over bars if the obstructions were removed. Of the traps encountered, 7 were old and had openings from 5 feet to 30 feet in width. At these obstructions the water surface drops from 1 to 3 feet. The remaining 7 traps blocked the river completely, and it was necessary to cut for the skiff a passage through the rock and pile obstructions.

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[1] Not printed.

21. In general the river is very crooked, with many sharp bends, at four of which the river has cut through the necks, thereby straightening the channel and shortening it from 0.5 to 3 miles. The cut-offs through the necks are not more than 300 feet long.

22. The soil exposed at the high banks is sand, clay, and rotten limestone, and in general the banks are heavily wooded down to about the mean stage line with a mixed growth. Where these banks are exposed at high water to the erosive action of the river current, they are caving into the river. At certain points, upon the subsidence of high water, portions of the saturated banks with the covering of forest growth slide into the river. One of the worst slides encountered is between the bridges at Shubuta. A bluff 80 feet high is sliding into the river, and at this point the minimum width of the river is about 15 feet.

23. The banks are so overhung with trees that high-stage navigation would be very difficult and dangerous.

24. In the 133 miles of river under consideration, 121 shoals, having a depth of less than 3 feet, were found. If the fish traps were removed and the water surface lowered, it is probable that more shoals would be discovered. With the exception of the 13 shoals of soft rock found in the section between Shubuta and Avera (68 miles), the 121 shoals found are due to the collection, by sunken rafts, logs, and snags, of masses of sand and gravel.

25. Apparently not more than 10 per cent of the area of drainage basin contiguous to the section of river under consideration is actually under cultivation. Notwithstanding the praiseworthy agitation for crop diversification and scientific farming any increase in the percentage of land actually under cultivation will probably take place very slowly. The heavy cost of removing pine stumps from the raw land, and the large annual expenditure for commercial fertilizer necessary to grow crops successfully, more than offset the apparent cheapness of the stump lands. While the bottom lands are naturally richer than the pine lands, the removal of the heavy covering of mixed growth will be a long and difficult task, and the occasional inundations from the various streams will also deter settlers from making full use of these lands.

26. As a general rule such logs as are available for transportation on this section of the river are obtainable only in seasons of such protracted rains as will cause the creeks to rise sufficiently to float logs safely into the large streams. Under these conditions the stage of the Chickasahay is at least 12 feet. Even the logs drawn from the interior to the banks of the larger streams by oxen are floated or rafted only at high stages.

The stream is practically unused for any other purpose than logging, and, as has been shown, it has been obstructed by numerous fish traps. It appears that little interest is taken in the navigation of the stream. No protest against this obstruction of the river has ever been received. When making the examination, personal requests were made for commercial statistics to supplement the information obtained by letter. In spite of promises, no commercial statistics have been received to date, as a result of these personal requests, which fact may argue lack of probable commerce rather than lack of interest.

27. From Enterprise, the head of the Chickasahay, to Bucatunna, the Mobile & Ohio Railroad follows the river valley, crossing it below Quitman and below Shubuta. From Leakesville, 50 miles by water below the Wayne County bridge near Bucatunna, the Alabama & Mississippi Railroad runs in a northeasterly direction about 16 miles to Vinegar Bend, where it joins the Mobile & Ohio Railroad. The New Orleans, Mobile & Chicago Railroad crosses the Pascagoula River about 0.2 miles below the mouth of the Chickasahay.

It is probable that the commercial needs of this rather sparsely settled region are sufficiently cared for by the railways, and perhaps the indifference of the inhabitants to the obstruction of the Chickasahay may best be accounted for by the lack of necessity for its use as a commercial route.

28. *Commercial statistics.*—As has been shown, diligent efforts were made to ascertain the water-borne commerce of the locality.

Copies[1] of the letter requesting information and of the replies[1] made thereto are inclosed herewith. The reply of the Chamber of Commerce of Hattiesburg was evidently a carbon copy of the statistics furnished by Mr. F. H. Lewis, of Pascagoula, and should not be considered as an independent communication. The errors in some of the estimates and reports are manifestly great.

To secure an independent check on the commerce, the master of the United States snag boat working on the Pascagoula was instructed to keep account of every raft and boat passing the snag boat and to ascertain its origin and destination. The statistics so collected were reported every 10 days. The commerce whose origin could not be ascertained has been distributed over the rivers in proportion to the commerce whose origin was known, so that each stream would be credited with a reasonable part of all the commerce. (See tabulated report on commercial statistics attached to this report.)

It is not believed that any naval stores have been brought down the Chickasahay recently. The principal commerce is logs, timber, lumber, and crossties, and these are brought down in the seasons of protracted rains, when the stage of river is so high that the rafts and logs can pass over the snags and obstructions as they now exist. On account of lack of buoyancy, crossties and hardwoods must be floated on the rafts of pine. There is no prospect for additional commerce under any feasible project of improvement, and the existing commerce, small as it is, will dwindle with the exhaustion of the supply of available timber. The transportation of crossties will probably stop when the rafting of pine does.

29. *Navigation features.*—At mean low water the controlling depth on the bars is about 1 foot and the minimum width of channel (disregarding the slide at Shubuta) about 30 feet. A low stage of the river is liable to exist at any time, but especially from June 1 to December 15. No commodities are moved by water in this period. At mean stage, which may occur at uncertain times between March 1 and June 15 and between November 15 and December 15, the controlling depth is about 7.5 feet, and the minimum width of channel is about 50 feet. No commodities are then moved by water, for cotton and cotton products are moved by rail from September 1 to January, and, as previously explained, rafting is not then possible. At high stage, which may occur between December 15 and March 1 (with the

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[1] Not printed.

possibility of an additional period between March 1 and April 30), the controlling depth is 28.8 feet and the minimum width is about 60 feet. During this period some rafts of logs and crossties and some loose logs are moved downstream. Above Shubuta the corresponding width and depth are less than those stated. The locality is connected with the sea by the Pascagoula. The controlling dimensions of the Pascagoula are as follows: Mean low water, depth 2.3 feet, width 50 feet; mean stage, depth 8.8 feet, width 150 feet; high stage, depth 9.8 feet, width 150 feet.

30. As far as concerns navigability, controlling depths, or controlling widths, it is not believed that the present condition differs widely from the original condition of the stream. It is true that artificial obstructions now exist, but the stream has never been an important waterway except in the period when the lumber companies were denuding the river basin of its heavy forest of pine. In that period the stream was important only for logging and rafting.

31. At Shubuta the maximum fluctuation is 44.1 feet; at Merrill, 24.1 feet. At mean low water the fall from the highway bridge at Shubuta to the railroad bridge at Merrill (a distance of 133 miles) is 118.9 feet. The stream is nontidal.

32. Due to the many fixed bridges, navigation by small steamboats would be dangerous at mean and high stages; and, due to the snags and other obstructions, navigation, even for rafts, would be dangerous at anything less than mean stage. A table of bridges will be found attached.

33. *Terminal facilities.*—There are no terminal facilities on the stream, nor are there any mechanical appliances for handling freight. There is no necessity or demand for either.

34. *Water power.*—No question of water-power development is involved.

35. *Local cooperation.*—There has been no local cooperation, and none may be expected.

36. *Land reclamation.*—No question of land reclamation arises for consideration.

37. *Conclusions and recommendations.*—On account of the small and decreasing commerce on the Chickasahay and the evident lack of need for its improvement at the present time, further expenditure of public funds at this time for the improvement or maintenance of this locality is not justified, and it is therefore recommended as unworthy of improvement by the United States.

C. KELLER,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., January 10, 1916.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded, concurring in the views and recommendation of the district officer.

J. C. SANFORD,
Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

List of towns located along Chickasahay River, showing 1910 census population, and approximate distance from the river.

Town.	Population.	Distance from river.	Town.	Population.	Distance from river.
MISSISSIPPI.			MISSISSIPPI—continued.		
		Miles.			*Miles.*
Shubuta	850	0.2	Chicora	225	(2)
Eucutta	100	10.0	Uriel	25	4.0
Hiwannee (sawmill town)	[1] 75	(2)	Bucatunna	125	2.0
Frostbridge	50	12.0	Mason	25	5.0
Westking	[1] 75	(2)	Stateline	275	6.0
Tokio	15	6.0	Countyline	25	2.0
Gretna	13	10.0	Avera	46	(2)
Boyce	20	.5	Jonathan	50	8.0
Whistler	50	10.0	Betty	25	6.0
Amazon	32	9.0	Leakesville	525	(2)
Britton	25	9.5	Rounsaville	25	5.0
Waynesboro	650	2.0	Vernal	57	4.0
Denham	27	8.0			
Winchester	75	[3] 1.0	Total	3,508	....
Clara	23	8.0			

[1] Estimated. [2] At river. [3] Railroad connection at Chicora.

Bridges spanning the Chickasahay River, from its mouth to Shubuta, Miss.

Name.	Location (nearest town).	Character.	Distance above mouth.	Channel spans.			Remarks.
				Clear width, normal to channel.	Clear height above—		
					Mean low water.	Mean high water.	
			Miles.	*Feet.*	*Feet.*	*Feet.*	
Clarke County bridge.	Shubuta, Miss	Steel, fixed	133.0	155.8	40.6	10.9	Concrete; steel cylindrical piers on either bank.
Mobile & Ohio R. R. bridge.	do	do	130.0	150.0	40.4	10.9	Brick piers on either bank.
Do	Westking, Miss	do	118.0	146.0	39.0	10.4	Pile cluster piers on either bank.
Wayne County bridge.	Waynesboro, Miss	do	105.0	160.4	45.8	18.1	Concrete; steel cylindrical piers on either bank.
Do	do	do	93.0	206.4	34.0	7.1	Do.
Mobile & Ohio R. R. bridge.	Chicora, Miss	do	85.0	148.0	29.0	2.6	Pile cluster piers on either bank.
Wayne County bridge.	Bucatunna, Miss	do	82.0	211.5	34.9	8.8	Concrete; steel cylindrical piers on either bank.
Greene County bridge.	Avera, Miss	do	65.0	215.6	37.4	12.4	Do.
Do	Leakesville, Miss	do	32.2	196.0	42.3	19.7	Concrete; steel cylindrical piers; left pier in river; right pier on bank.
Alabama & Mississippi R. R. bridge.	do	do	32.0	148.0	32.3	9.7	Pile cluster piers; both in river.
Greene County bridge.	Merrill, Miss	do	8.0	214.8	35.3	14.2	Concrete; steel cylindrical piers on either bank.

Commerce on Chickasahay River for the calendar years 1910, 1911, 1912, 1913, and 1914.

Articles.	1910		1911		1912		1913		1914	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
Round logs	40,000	$200,000	62,500	$250,000	48,000	$240,000	75,000	$375,000	44,400	$166,500
Hewn and sawn timber	16,000	152,000	6,000	60,000	4,800	36,000	7,500	56,250	8,160	30,600
Hardwood	1,250	8,000	2,500	8,000	1,200	7,000	2,250	15,000	1,265	6,325
Crossties	......	....	......	....	......	....	......	....	12,798	51,190
General merchandise	30	1,500	15	750	5	225	5	500	......	....
Total	57,280	361,500	71,015	318,750	54,005	283,225	84,755	446,750	66,623	254,615

Principal destination of above, Pascagoula and Moss Point, Miss.
It is impracticable to obtain ton-mile statistics.

Comparative statement of commerce on Chickasahay River, as it has been obtained from different parties.

Articles.	Calendar year 1914, by Commercial Club, of Hattiesburg, Miss., and by F. H. Lewis, of Pascagoula, Miss.	F. B. Merrill's estimate (made verbally).	Letter of Dorsett Bros. & Co., of Merrill, Miss., in answer to Col. Keller's letter of June 18, 1915.[1]	Oct. 1, 1914, to Sept. 30, 1915, as obtained by Capt. A. Q. Hunt, of United States snag boat, for 12 months.	Bear Creek Mill Co., Leakesville, Miss. (Wm. H. Louisell).
Round logs.....pieces	55,500	13,500	1,000,000	2,733	[2] 50,000,000,000–75,000,000,000
Sawn and hewn timber.....do	5,100	7,500	90,000	55,460	
Hardwood.....do	1,150	....	....	....	....
Crossties.....do	127,976	....	200,000	14,120	....
Staves.....do	....	....	60,000	....	....
Turpentine.....gallons	....	....	125,000	....	....
Rosin.....barrels	....	....	75,000	....	....
Lumber.....feet b. m.	....	....	....	40,000	....
Short tons (2,000 pounds)	66,625	21,000	1,125,950	58,375	100,000,000–150,000,000

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[1] This report must be of both the present and what Mr. Dorsett regards as the prospective commerce, as investigation fails to show that at present any naval stores are being transported by water in this locality. The report of the Bear Creek Mill Co. shows more commerce than the total cut of all woods in the United States for the year 1913. The total cut of yellow pine in the United States for 1913 was 15,000,000,000 feet (World's Almanac, 1915, p. 141). While there is a difference between the reports of F. H. Lewis and Capt. Hunt as to the amount of sound and square timber, the totals agree reasonably well, and these reports are regarded as approximately correct. The estimated approximate value of the commerce reported by F. H. Lewis is $490,000.

[2] Feet b. m. of logs, timber, and lumber.

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64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1731.

ARROYO COLORADO, TEX.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION OF ARROYO COLORADO, TEX., UP TO HARLINGEN.

DECEMBER 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

WAR DEPARTMENT,
Washington, December 11, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, together with copy of a report from Lieut. Col. (now Col.) C. S. Riché, Corps of Engineers, dated May 6, 1914, on a preliminary examination of Arroyo Colorado, Tex., up to Harlingen, made by him in compliance with the provisions of the river and harbor act approved July 25, 1912.

Very respectfully,

WM. M. INGRAHAM,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, November 2, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination of Arroyo Colorado, Tex., up to Harlingen.

1. There is submitted herewith for transmission to Congress report dated May 6, 1914, by Lieut. Col. (now Col.) C. S. Riché, Corps of Engineers, on preliminary examination authorized by the

river and harbor act approved July 25, 1912, of Arroyo Colorado, Tex., up to Harlingen.

2. The Arroyo Colorado has a length of about 50 miles, and empties into the Laguna Madre about 26 miles from Brazos Santiago entrance. From the mouth to Harlingen is a distance of about 31 miles. The projected line of the proposed intracoastal waterway passes through the Laguna Madre about 3 miles from the mouth of the stream, and the improvement of the latter is desired in order to provide a connection with the intracoastal waterway which would afford facilities for the shipment of the products of the lower Rio Grande Valley. There is at present no commerce or navigation on the river and none is practicable without improvement. The district officer is of opinion that the stream is worthy of improvement by the United States, as a feeder to section 11 of the intracoastal canal, which, if built, will extend from Aransas Pass to Brazos Santiago. The division engineer is of opinion that the locality is not worthy of improvement at the present time.

3. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith dated July 11, 1916. The board calls attention to the fact that if this stream were improved it would have no outlet, as there is no navigable channel through Laguna Madre, and as no provision has been made for such a channel it is manifest that at this time improvement of the Arroyo Colorado would serve no useful purpose. The board therefore concurs with the division engineer in the opinion that it is not advisable for the United States to undertake the work.

4. After due consideration of the above-mentioned reports, I concur in the views of the division engineer and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Arroyo Colorado, Tex., up to Harlingen is not deemed advisable at the present time.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 11, 1916.

The Chief of Engineers, United States Army:

1. The following is in review of the district officer's report authorized by the river and harbor act of July 25, 1912, on preliminary examination of Arroyo Colorado, Tex., up to Harlingen.

2. The Arroyo Colorado rises in Hidalgo County, Tex., and empties into the Laguna Madre about 26 miles from Brazos Santiago entrance. It is about 50 miles long. The reach under consideration is 31 miles long. The lower 3 miles of the river and the 3 miles across the Laguna Madre to the line of the proposed intracoastal canal is through very shoal water, much of it being less than 6 inches in depth. The upper portion of the reach is in fairly good navigable condition.

3. There is at present no commerce or navigation on the stream and none is practicable without radical improvement in the lower reach. The Arroyo reaches into the present active development of the lower Rio Grande Valley, and if improved in connection with the intracoastal canal would furnish a transportation route for the products of that section in competition with the one existing railroad. The district officer is of opinion that the Arroyo Colorado is worthy of improvement as a feeder to the Laguna Madre section of the intracoastal canal. The division engineer calls attention to the fact that the construction of the Laguna Madre section of the canal has not been authorized, and therefore he does not regard the improvement of the Arroyo Colorado as a feeder advisable at this time.

4. The board was not convinced by the information furnished of the advisability of the improvement, and interested parties were so informed and given an opportunity of submitting statements and arguments to the board, but no communications on the subject have been received.

5. This waterway has never been improved by the United States, and in its present condition is not susceptible of useful navigation. If it were improved it would have no outlet, as there is no navigable channel through Laguna Madre into which it flows, and as no provision has been made for such a channel it is apparent that at this time improvement of the Arroyo Colorado would serve no useful purpose. The board therefore concurs with the division engineer in the opinion that at this time it is not advisable for the United States to undertake the improvement of the Arroyo Colorado, Tex., up to Harlingen.

6. In compliance with law the board reports that there are no questions of terminal facilities, water power, or other related subjects having any material bearing upon the improvement of navigation at this locality.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF ARROYO COLORADO, TEX.

UNITED STATES ENGINEER OFFICE,
Galveston, Tex., May 6, 1914.

From: District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of the Arroyo Colorado, Tex.

1. In compliance with instructions dated August 3, 1912, the following report on the recent examination of the Arroyo Colorado, Tex., to determine the advisability of improving the same for the present and future needs of navigation, is submitted.

2. The Arroyo Colorado rises in Hidalgo County, Tex., and flows northeasterly through Cameron County, emptying into the Laguna Madre about 26 miles from Brazos Santiago entrance. It is about 50 miles long.

3. The portion of the river examined, i. e., from the St. Louis, Brownsville & Mexico Railroad bridge to the mouth is divided by natural conditions into two sections:

First. From a connection with the proposed line of the intercostal canal in the Laguna Madre to a point 3 miles above the mouth of the Arroyo, at the junction of its branches.

Second. From mile 3 to the St. Louis, Brownsville & Mexico Railroad bridge at Harlingen (mile 31).

4. The lower portion from the point where the stream forks at mile 3 and the reach across the Laguna Madre, a distance of 3 miles to the line of the proposed intercostal canal is through very shoal water, a considerable distance having less than 6 inches of water. The length of this section is about 6 miles. At mile 3, the character of the arroyo changes, the banks becoming higher and the water much deeper. The banks are practically free from standing timber and the arroyo clear of obstructions with the exception of a shoal at mile 10. This section of the arroyo is already in condition for craft of 5 feet draft, with the exception of this one shoal, which can be removed with a slight amount of dredging.

5. The arroyo, as far as examined, is tidal and no power development is possible. The elevation of the normal water surface is very constant. Occasional freshets increase this level as much as 10 feet, and extreme low tides in the Laguna Madre decrease the level as much as 1 foot. The changes are due to local causes and have no stated periods. There exists at present no landing facilities, but as the arroyo is deep close to the banks no trouble would be encountered in providing such at suitable points as soon as the conditions would warrant. Several drainage ditches from the existing irrigation systems empty into the stream and these are depositing a limited amount of silt. This feature, however, can be easily eliminated.

6. The Arroyo Colorado reaches practically to the center of the present active development of the lower Rio Grande Valley and will furnish in connection with the main line of the intercostal canal through the Laguna Madre a water outlet for the products of this section. The country adjacent is rapidly developing. While the section of the intercoastal canal adjacent to the mouth of the Arroyo has not yet been constructed, its construction has been favorably recommended by the Chief of Engineers in a report on the entire intercostal route from Choctawhatchee Bay, Fla., to the Rio Grande (H. D. 610, 63d Cong., 2 sess.), and the Arroyo Colorado would be an essential feeder for this canal, particularly by reason of its central location with respect to the irrigated portion of the lower Rio Grande Valley.

7. There is no commerce on the stream at present, owing to lack of improvement. The entire lower Rio Grande Valley is served by only one railroad, the St. Louis, Brownsville & Mexico, which has its southern terminus at Brownsville, and it is very much in need of other transportation facilities. The railroad is admittedly unable to keep pace with the development of the valley and has to refuse freight. As an indication of this it is stated that the railroad company paid out in 1912, $165,000 for claims on car shortage and inability to serve the truck growers of the valley. The freight handled by this road has increased from 296,317 tons in 1908 to 821,244 tons in 1913, but it has about reached its limit, and at present production

in the valley is being kept down for lack of means of getting products to market. If water transportation is afforded, the tonnage will increase rapidly.

8. Separate statistics have been impossible of attainment for the section immediately adjacent to the arroyo, but statistics for the entire Rio Grande Valley have been received and are submitted herewith. As the arroyo penetrates practically to the center of the valley, such of this information as is applicable has been applied to this report. As has been stated before in this report all freight inbound and outbound is at present carried by the St. Louis, Brownsville & Mexico Railroad. For the fiscal year 1913 this road carried 821,244 tons of freight. It is stated that 80 per cent of this, or about 657,000 tons, was handled in and handled out of the lower Rio Grande Valley. Assuming that only 10 per cent of this would be diverted to the arroyo should it be improved, there would be 65,700 tons carried in and out by water annually. If water transportation be provided, furnishing a connection to Aransas Pass and Galveston and other seaports through the main line of the intracoastal waterway, production in the valley will receive an impetus and the tonnage above given will be correspondingly increased.

9. The outbound freight consists of cotton, cottonseed, and cottonseed products, the proportionate tonnage of which has increased rapidly, early vegetables, cabbage, onions, rice, sugar, and molasses, and other agricultural products. It originates at all points in the valley and is shipped east, largely by way of Galveston. Inbound freight consists of lumber and other building material, crude oil, agricultural implements and other machinery, coal, household goods, general merchandise, and groceries, and all the other manufactured products which are hauled into a new and rapidly developing country. It originates at various eastern points and is destined for all points in the valley. Parts of the freight, the early vegetables and other perishable goods, will always go by rail, but should water communication be established it is believed a large part of the bulkier commodities, such as cotton, rice, etc., and a large part of the inbound freight will seek the water route.

10. There are inclosed herewith resolutions[1] of the Mission Truck Growers' and Farmers' Association, resolutions[1] of the Valley Bankers' Association, resolutions[1] of the Commercial Club of Kingsville, Tex., resolutions[1] of the Arroyo Colorado Intercoastal Canal League, resolutions[1] of the South Texas Gardeners, a sketch map[1] showing the general location of the Arroyo Colorado and its connection with the proposed main line of the intracoastal waterway, and report[1] of L. P. Morrison, junior engineer, and the statistics[1] mentioned in paragraph 8, marked "Exhibits A1, A2."

11. In view of all of the above, therefore, I have the honor to report that the Arroyo Colorado is worthy of improvement by the United States as a feeder to the Laguna Madre section of the intracoastal canal, described in the above-named report as "Section 11, Aransas Pass to Brazos Santiago," and, further, that its improvement should be for similar depth and width in all artificial cuts, 5 feet depth, and 40 feet bottom width, and should be undertaken at the same time as is the improvement of said section 11.

C. S. RICHÉ,
Lieutenant Colonel, Corps of Engineers.

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[1] Not printed.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., May 11, 1916.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded.

2. The above is a report on a preliminary examination of the Arroyo Colorado, Tex., up to Harlingen, as directed by the river and harbor act of July 25, 1912. The examination covers the distance from Harlingen to the line of the intracoastal waterway in the Laguna Madre, as recommended in House Document No. 610, Sixty-third Congress, second session, this portion of the intracoastal waterway being designated as section 11, Aransas Pass to Brazos Santiago. The construction of this section has not been authorized by Congress.

3. As the country lying along a large part of the section is practically uninhabited, the main advantage of constructing the section of the waterway as a whole would be to afford water transportation for the products of the fertile and well settled lower Rio Grande Valley, which would be reached by the section of the waterway at its southern end. At present, however, there does not appear to be a strong demand from the people of the valley for the construction of section 11, as, on account of the great length of the section, taken in connection with the limited transportation facilities that would be afforded by the intracoastal waterway as recommended, it is believed by them that a better outlet for their products would be by seagoing vessels, using Brazos Santiago entrance. It therefore appears to me doubtful if the whole of section 11 will be constructed in the immediate future.

4. The district officer reports that the Arroyo Colorado is worthy of improvement by the United States, as a feeder to said section 11. In view of the fact that the construction of section 11 has not yet been authorized, it is my opinion that the Arroyo Colorado as a feeder thereto is not worthy of improvement at the present time.

J. C. SANFORD,
Colonel, Corps of Engineers, Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors, see p. 2.]

64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1732.

CHANNEL AT AUSTWELL, TEX.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION FOR A CHANNEL AT AUSTWELL, TEX., TO CONNECT WITH THE INLAND WATERWAY IN SAN ANTONIO BAY.

DECEMBER 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 11, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated October 31, 1916, together with copy of a report from Lieut. Col. (now Col.) C. S. Riché, Corps of Engineers, dated June 28, 1916, with map, on a preliminary examination of Austwell, Tex., to a connection with the inland waterway in San Antonio Bay, made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

WM. M. INGRAHAM,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, October 31, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination for a channel at Austwell, Tex., to connect with the inland waterway in San Antonio Bay.

1. There is submitted herewith for transmission to Congress report dated June 28, 1916, with map, by Lieut. Col. (now Col.) C. S. Riche, Corps of Engineers, on preliminary examination authorized by the

river and harbor act approved March 4, 1915, of Austwell, Tex., to a connection with the inland waterway in San Antonio Bay.

2. Austwell has a population of about 300, and is situated on the west shore of Hynes Bay, an arm of San Antonio Bay, about 5 miles from the Guadalupe River branch of the intracoastal waterway and 8 miles from the town of Seadrift. The improvement apparently desired is a channel 2½ feet deep at mean low tide from the shore to equal depth in Hynes Bay, a distance of about 2,200 feet. The intracoastal waterway has a depth of 5 feet, and to carry this depth to Austwell would require dredging the entire distance of 5 miles. The commerce of the vicinity is small and is handled almost entirely by rail. In the opinion of the district officer, the locality is not worthy of improvement by the United States at this time. The division engineer concurs in this opinion.

3. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 25, 1916, concurring in the views of the district officer and the division engineer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Austwell, Tex., to a connection with the inland waterway in San Antonio Bay is not deemed advisable at the present time.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 25, 1916.

The Chief of Engineers, United States Army:

1. The following is in review of the district officer's report authorized by the river and harbor act of March 4, 1915, on preliminary examination of Austwell, Tex., to a connection with the inland waterway in San Antonio Bay.

2. Austwell, with a population of about 300, is situated on the west shore of Hynes Bay, an arm of San Antonio Bay, about 5 miles from the Guadalupe branch of the inland waterway and 8 miles from the town of Seadrift. No improvement of the channel leading to Austwell has been undertaken by the United States. The average depth in Hynes Bay is only about 3 feet, while the project depth of the inland waterway is 5 feet.

3. The improvement desired is stated to be a channel 2½ feet deep at mean low tide, beginning at this depth in Hynes Bay and extending to the shore line, a distance of about 2,200 feet. A channel of the same depth as the inland waterway would require dredging the entire distance of 5 miles between that waterway and Austwell.

4. There is very little water-borne commerce, and the entire estimated tonnage in and out of the locality is 20,300 tons, handled prin-

cipally by rail. One small launch lands occasionally to take on freight and passengers for Seadrift or other local points. The district officer reports the locality as not worthy of improvement by the General Government at this time, and the division engineer concurs in this view.

5. Interested parties were informed of the unfavorable report of the district officer and given an opportunity of submitting statements and arguments to the board, but no communications on the subject have been received.

6. The improvement contemplated would accommodate vessels of very small capacity only, and little development of commerce could reasonably be expected to result from this work. The channel extends out into the shallow bay across the line of the tidal flow, and the cost of maintenance would be high, possibly as much annually as the original cost of the work. In view of these conditions, the board concurs with the district officer and the division engineer in the opinion that it is not advisable at this time for the United States to undertake the construction of a channel from Austwell, Tex., to a connection with the inland waterway in San Antonio Bay.

7. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other related subjects which could be coordinated with the suggested improvement in such manner as to render the work advisable in the interests of commerce and navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION FOR A CHANNEL AT AUSTWELL, TEX.

UNITED STATES ENGINEER OFFICE,
Galveston, Tex., June 28, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination for a channel at Austwell, Tex.

1. In compliance with instructions contained in letter from the Office of the Chief of Engineers, dated March 15, 1915, I submit report on the item contained in the river and harbor act of March 4, 1915, as follows:

> SEC. 15. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following named localities: * * * Austwell, Texas, to a connection with the inland waterway in San Antonio Bay.

2. The field examination was made by Mr. E. B. Sandelands, inspector from this office to whose report, which is attached, attention is invited.

3. Austwell, a town of about 300 people is situated on the west shore of Hynes Bay, an arm of San Antonio Bay, about 9 miles directly across this latter bay from the town of Seadrift and 10 miles from the mouth of Guadalupe River. It is a new town having been

founded only a few years ago and is the terminus of the Tivoli-Austwell branch of the St. Louis, Brownsville & Mexico Railroad. The branch of the inland waterway to the mouth of the Guadalupe River passes through San Antonio Bay 5 miles distant from the town. The average depth in Hynes Bay is only about 3 feet at mean low tide and there are numerous oyster roofs or "towheads."

4. The farmers in the country surrounding and tributary to Austwell raise little else but cotton. Statistics gathered by Mr. Sandelands show the estimated tonnage in and out of Austwell and the adjacent towns of Maudlowe and Tivoli, which would probably be tributary to Austwell if a channel were excavated there, to be for the year ending August 31, 1915, as follows:

Town.	Out.	In.
	Tons.	*Tons.*
Austwell	9,000	6,000
Tivoli	2,000	1,500
Maudlowe	1,000	800
Total	12,000	8,300

The outbound freight is practically all cotton. The present railroad rates from Austwell to Port Aransas, Galveston, and Houston are 39, 46, and 46 cents per hundred pounds, respectively. The rate by barge from Seadrift, across the bay from Austwell, to the same points are at present 15 to 20 cents to Port Aransas, 22 cents to Galveston, and 25 cents to Houston. Seadrift, however, has a deeper channel than the 2½ feet asked for Austwell. This channel would limit the number of boats that could use it. It is believed, however, that water rates of 20, 22, and 25 cents, respectively, per hundred pounds on cotton would apply, showing a saving of about $45,000 on the 12,000 tons to Aransas Pass, $57,000 to Galveston, and $50,000 to Houston. In addition to this there would be some lumber and merchandise inbound. For the season of 1916 it is estimated that there will be 10,000 bales of cotton ginned. Estimated value of lumber brought in $50,000, and of merchandise brought in $275,000, for 1916.

5. The people interested in the improvement desire a short channel excavated with a depth of 2½ feet at mean low tide, beginning at this depth in Hynes Bay and extending in to the shore line. The town is located on a steep bluff, but the inner end of the channel is to be located at the mouth of a dry gully or ditch, which can at small expense to the people interested be converted into a highway leading from the town to the channel. The proposed channel would be about 2,200 feet long. It would not, however, connect directly with the inland waterway, and as that waterway has a project depth of 5 feet all boats using the inland waterway could not get to Austwell. A channel with depth of 5 feet to Austwell would have to be about 5 or 6 miles long to connect with the inland waterway, as there is less than that depth at present in the bay over the route of such a channel between these two points.

6. There is no water-power development possible, nor any other subject that could be considered in connection with the improvement to lessen the cost to the United States. Terminal facilities at present

consist of one small wharf, about 4 feet wide and 310 feet long, extending out from shore at the town, and at which one small launch lands at irregular intervals to discharge and take on freight and passengers to and from Seadrift and other adjacent points. Terminal facilities can be constructed at small expense by the people interested, as there is ample room for such development along the shore.

7. It is believed that as a condition precedent to the construction of such a channel by the Government, and in order that such channel may be able to accomplish the purpose for which it is intended, the people most interested should obligate themselves to construct a suitable public wharf with warehouse having direct rail and highway connection and open to all carriers on equal terms, and there seems to be no present likelihood that this will be done. Chiefly for this reason, therefore, it is believed that Austwell, Tex., to a connection with the inland waterway is an improvement not worthy of being undertaken by the General Government at this time.

8. There is inclosed herewith report of Mr. E. B. Sandelands, inspector, and sketch map of the locality.

C. S. Riché,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

Office of Division Engineer, Gulf Division,
New Orleans, La., July 7, 1916.

The Chief of Engineers:

1. Forwarded.

2. The improvement desired would be of purely local benefit. The annual maintenance cost would probably be about equal to the first cost of dredging the channel. By hauling their freight a few miles farther the farmers interested can reach the Guadalupe River, which is now connected by a good navigable channel, recently dredged, with the inland waterway. For these reasons, in addition to the reason mentioned by the district officer, I concur in his opinion that the locality is not now worthy of improvement by the General Government.

J. C. Sanford,
Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

REPORT OF INSPECTOR SANDELANDS.

Galveston, Tex., *October 30, 1915.*

From: E. B. Sandelands, inspector.
To: The District Engineer Officer.
Subject: Examination of Austwell, Tex., with a view to connection with inland waterway.

1. I herewith respectfully submit the following report on examination of Austwell, Tex., with a view to connection with the inland waterway, made under appropriation for examinations, surveys, and contingencies of rivers and harbors.

DESCRIPTION.

2. Austwell, a town of about 300 inhabitants, in Refugio County, Tex., is situated on a bluff bank on the west shore of Hynes Bay, an arm of San Antonio

Bay. There are located there a cottonseed oil mill, a cake mill, and a cotton gin. It is the terminus of the St. Louis, Brownsville & Mexico Railway Co., Tivoli branch, and is about 16½ miles by rail from Heiser, the junction of the Tivoli line with the branch line from Bloomington to Port O'Connor. Other distances are as follows: To Houston, 172 miles; to Brownsville, 239 miles. By water it is about 172 miles from Galveston, 9 miles from Seadrift, and about 70 miles from Corpus Christi, while to the Guadalupe branch of the inland waterway the distance is 5 miles. Hynes Bay is much the same as upper San Antonio Bay, having about 3 feet of water at mean low tide and containing numerous oyster reefs.

COMMERCIAL ACTIVITIES.

3. The farmers in the country tributary to Austwell raise cotton only. Estimated tonnage in and out of Austwell, Maudlowe, and Tivoli (the latter two being adjacent towns located in the same farming territory) for the year ending August 31, 1915, is as follows:

Town.	Out.	In.
	Tons.	*Tons.*
Austwell	9,000	6,000
Tivoli	2,000	1,500
Maudlowe	1,000	800
Total	12,000	8,300

Total tons of 2,000 pounds of freight moved	20,300
Estimated ginning for season of 1916 ... bales	10,000
Estimated value of lumber to move	$50,000
Estimated value of merchandise to move	$275,000

TERMINAL AND WATER-POWER FACILITIES.

4. There are no water-power facilities. Terminal facilities can be built at small cost to interests who are desirous of improvement of the bay immediately in front of Austwell. At present a small wharf exists, as indicated on accompanying map.

IMPROVEMENT.

5. A plan of improvement would call for dredging in Hynes Bay. The sentiment expressed by the people desiring improvement was for a short channel from about 2½ feet of water at mean low tide, in Hynes Bay to the shore line at such a point as would be easily accessible to wagons. As the bluff on which the town is located is steep, and the sloping banks are too far away from the town to afford a point of any practical use as a terminal, a dry ditch was chosen at the shore end of the channel. This can, at small expense to the people or transportation company using the channel be converted into a road leading to the terminal. The proposed channel is approximately 2,200 feet long and will give 2½ feet of water at mean low tide, and for the greater part of the year 3½ feet. All soundings shown on accompanying map are referred to the plane of mean low tide of the Gulf.

WORK PERFORMED.

6. Party left Galveston on leased launch *Ike* on July 1, 1915, and arrived at Austwell September 7, 1915. Examination was made September 7 to 9, 1915. Shore line was first run by stadia, tying in the town of Austwell, and soundings were taken in Hynes Bay and located by transit ashore.

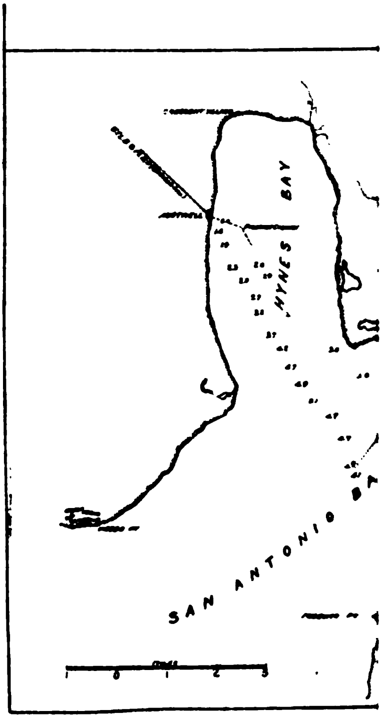
CONCLUSIONS.

7. The small amount of work required to improve the bay in front of Austwell by dredging a channel as suggested, coupled with the fact that such improvement would be of great benefit in lowering the freight on cotton and merchandise moving through Austwell, makes it apparent that it would be desirable to commence work as soon as possible, and it is so recommended.

INCLOSURES.

8. There is herewith transmitted map showing Austwell and the limits of the examination.

E. B. SANDELANDS, *Inspector.*



THE NORRIS PETERS CO., WASHINGTON, D. C

64th Congress, 2d Session. } HOUSE OF REPRESENTATIVES. { Document No. 1733.

LAKE RIVER, WASH.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION OF LAKE RIVER, WASH.

December 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

War Department,
Washington, December 11, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 10th ultimo, together with copy of a report made by Maj. H. C. Jewett, Corps of Engineers, dated September 7, 1916, on a preliminary examination of Lake River, Wash., made by him in compliance with the provisions of the river and harbor act approved July 27, 1916.

Very respectfully,

Wm. M. Ingraham,
Acting Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, November 10, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination of Lake River, Wash.

1. There is submitted herewith for transmission to Congress report dated September 7, 1916, by Maj. H. C. Jewett, Corps of Engineers,

on preliminary examination authorized by the river and harbor act approved July 27, 1916, of Lake River, Wash.

2. Under authority of the river and harbor act of March 4, 1913, a preliminary examination and survey were made of this locality, and the reports thereon are printed in House Document No. 1176, Sixty-third Congress, second session. The recommendation of the department was favorable for the improvement of the stream to the extent of securing by dredging a channel 50 feet wide and 6 feet deep from the mouth to Ridgefield, at an estimated cost of $1,600 for first construction and $500 annually for maintenance. The improvement recommended appears to meet the present needs and desires of the locality, and therefore no further action by the War Department seems necessary.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
September 26, 1916.

To the Chief of Engineers, United States Army:

1. In this report on preliminary examination of Lake River, Wash., submitted under authority of the river and harbor act of July 27, 1916, it is stated that the improvement desired is fully covered by a favorable report submitted under authority of the river and harbor act of March 4, 1913, and printed in House Document No. 1176, Sixty-third Congress, second session.

2. The recommendation in that report is for a channel 50 feet wide and 6 feet deep in Lake River from the mouth to Ridgefield. The district officer states that a channel of these dimensions is sufficient for all purposes of navigation, and it appears from the quotation from the letter of the Commercial Club of Ridgefield that nothing further is desired at this time, and that the call for the present examination is due to a misunderstanding.

3. In view of these facts, it is suggested that the report be forwarded to Congress with the statement that no further action by the War Department appears necessary.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF LAKE RIVER, WASH.

United States Engineer Office, Second District,
Portland, Oreg., September 7, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Lake River, Wash.

1. In compliance with department letter of August 4, 1916, the following report is submitted on the preliminary examination of Lake

River, Wash., provided for in section 2 of the river and harbor act of July 27, 1916.

2. Lake River empties into the Columbia River near the mouth of Lewis River, about 14 miles below the mouth of the Willamette River and 26 miles from the city of Portland. The total length from Vancouver Lake at the head is about 11 miles. At mean low water it averages in width about 75 feet at the head and about 350 feet at the mouth. The banks are of clay and loam, fairly stable, and are from 10 to 21 feet in height above low water. From Vancouver Lake the river flows in a northwesterly direction about 2½ miles, then northerly about 5½ miles, and then northwesterly about 3 miles to the mouth. Several small creeks empty into the river along the right bank, but the stream generally is sluggish, due to the effect of tidal flow in the Columbia River. Bachelors Slough, a secondary channel of the Columbia River, leaves the Columbia about 3½ miles above the mouth of Lake River and flows in a northeasterly direction for about 3 miles and empties into Lake River about 1½ miles above the mouth and about 1 mile below Ridgefield. The average variation of water level due to tide is about 2 feet at the mouth.

3. Above Ridgefield there are numerous short bends, snags, and several shoals, over which there is a minimum depth of about 1 foot; below Ridgefield there is a low-water depth ranging from about 7 to 36 feet, except at the mouth of the river, where there is a depth of about 3½ feet.

4. The land along the right bank of Lake River, except near the mouth, rises to an elevation of about 100 to 150 feet above the river. The surrounding territory is well settled by a prosperous agricultural community. The land adjacent to the left bank generally is low and swampy, with numerous shallow lakes formed by the backwater from the Columbia River. During the annual freshet in May, June, and July, the greater portion of this tract is overflowed. The land is used principally for grazing and dairying purposes. The main line of the Northern Pacific Railway from Portland to Puget Sound runs along the face of the hills and from Felida, at the head of Lake River, parallels the river to Ridgefield, a distance of about 8 miles.

5. Ridgefield, 14 miles from Vancouver, Wash., on the main line of the Northern Pacific Railway and 2½ miles above the mouth of Lake River, is the distributing point for the surrounding territory and the head of navigation for the regular steamboat service, although trips are made occasionally to private landings farther upstream. During the extreme low stage of water on the east fork of Lewis River, freight to and from La Center is frequently hauled by team through Ridgefield. Above Ridgefield the river is used principally for rafting logs and by towboats and launches. The logs are hauled by rail from the logging camps to Felida, where they are boomed and rafted and then towed to points on the Columbia and Willamette Rivers.

6. Between Ridgefield and Portland a gasoline boat, the *Mimare*, carrying freight and passengers, makes a round trip daily, and in addition to this service the steamboat *Metlako*, plying between Portland and Woodland on the north fork of the Lewis River, makes a way landing at Ridgefield. The steamboats, including towboats,

are of the stern-wheel type, about 150 feet long, 30 feet beam, and from 2 to 6 feet draft.

7. Freight to and from Ridgefield consists of general merchandise, agricultural products, lumber, and shingles, but definite commercial statistics are not available. It is estimated that the annual tonnage to and from Ridgefield averages about 5,000 tons in addition to large quantities of ties, which are towed from Lewis River and other points to Ridgefield for shipment by rail.

8. The terminal facilities at Ridgefield consist of a private dock and warehouse leased to the *Mimare* and a free public landing wharf owned by the town of Ridgefield. Freight is handled on trucks and is loaded and unloaded by the deck hands on the boat. Rail and boat terminals do not connect, as only local freight is carried on the boats.

9. There is no water-power development which could be coordinated to advantage with any plan of improvement of Lake River.

10. A report, with map, on a preliminary examination and survey of Lake River, including Bachelors Slough, Wash., made in accordance with the provisions of the river and harbor act of March 4, 1913, is contained in House Document No. 1176, Sixty-third Congress, second session. The recommendation of the district officer contemplated securing by dredging a channel 50 feet wide and 6 feet deep in Lake River from the mouth to Ridgefield, and by dredging and snagging a channel 50 feet wide and 4 feet deep throughout the length of Bachelors Slough at a total estimated cost of $4,850 and approximately $1,000 annually for maintenance.

11. The review of the district officer's reports by the Board of Engineers, concurred in by the Chief of Engineers, was favorable to the improvement of Lake River in the manner proposed at an estimated cost of $1,600 for first construction and $500 annually for maintenance, and was unfavorable as to the improvement of Bachelors Slough.

12. The subject of this report has been taken up with the Ridgefield Commercial Club with a view to ascertaining the character and extent of the improvement desired, and in reply the chairman of the river and harbor committee of the club states "that the Ridgefield Commercial Club was instrumental some time ago in having inserted in the river and harbor act an item authorizing the preliminary examination and survey of Lake River and Bachelors Slough. This survey was made and report thereof submitted, but through misunderstanding Congress has been again called upon to authorize the same work," and he further states that "the organization is in full accord with the recommendation to improve Lake River from the mouth to Ridgefield by providing a channel 50 feet wide and 6 feet deep at low water."

13. A channel of the above dimensions is considered sufficient for all purposes of navigation and in my opinion the improvement is worthy of being undertaken by the United States.

14. The report on previous examination and survey above mentioned, contains all essential data and as the item in the river and harbor act of July 27, 1916, calling for this report was apparently inserted through a misunderstanding, a resurvey appears unneces-

sary and is not recommended. For the same reason a sketch map is not submitted with this report.

HENRY C. JEWETT,
Major, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER,
NORTHERN PACIFIC DIVISION,
Portland, Oreg., September 8, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded, concurring in the views of the district officer as expressed in paragraph 13.

CHAS. L. POTTER,
Lieutenant Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors, see p. 2.]

64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1734.

DELAWARE RIVER, FROM MOUTH OF COOPER RIVER TO FISHERS POINT DIKE.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF DELAWARE RIVER, FROM MOUTH OF COOPER RIVER TO FISHERS POINT DIKE, ON THE NEW JERSEY SHORE, INCLUDING CONSIDERATION OF ANY PROPOSITION FOR COOPERATION ON THE PART OF LOCAL INTERESTS.

DECEMBER 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 12, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 27th ultimo, together with copies of reports from Col. G. A. Zinn, Corps of Engineers, dated September 21, 1915, and April 18, 1916, with map, on a preliminary examination and survey, respectively, of Delaware River from the mouth of Cooper River to Fishers Point Dike, on the New Jersey shore, including consideration of any proposition for cooperation on the part of local interests, made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

WM. M. INGRAHAM,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, November 27, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Delaware River from Cooper River to Fishers Point Dike.

1. There are submitted herewith for transmission to Congress reports dated September 21, 1915, and April 18, 1916, with map,

by Col. G. A. Zinn, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act approved March 4, 1915, of Delaware River from mouth of Cooper River to Fishers Point Dike, on the New Jersey shore, including consideration of any proposition for cooperation on the part of local interests.

2. Between Cooper River and Fishers Point the Delaware River is divided by Petty Island into two channels. The main channel passes to the westward of the island. The channel to the eastward of the island passes along, but some distance from, the water front of Camden, and this channel now has a depth of about 12 to 15 feet. Fishers Point Dike extends from Fishers Point about 4,500 feet toward the head of Petty Island, and was constructed for the purpose of securing an increased flow of water through the main channel of the river. Originally there was an opening 2,000 feet in length, but this has since been reduced by filling and there is now a full-depth opening of only 300 feet. Some shoaling has occurred to the east of Petty Island, particularly near the New Jersey shore, and local interests attribute this to the presence of the dike. The improvement now apparently desired is a channel 15 feet deep at mean low water and 300 feet wide from Fishers Point Dike to Cooper River, with some widening of the gap through the dike. The district officer presents an estimate for a channel of these dimensions, with an opening in the dike 800 feet wide, amounting to $72,875. He considers the locality worthy of improvement to this extent, but recommends that no work be done until the city of Camden has secured and opened for public use a wharf suitable for vessels capable of navigating the proposed channel. No definite offer of this or other cooperation, however, has been received. The division engineer sees no reason at present for dredging in the channel between Petty Island and the New Jersey shore, but he concurs in recommending that the opening in the dike be increased to a width of 800 feet and a depth of 15 feet, at an estimated cost of $33,000.

3. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated October 17, 1916. The board states that a navigable channel with depth of 12 to 15 feet already exists on the line of the proposed improvement, but this is located some distance from the New Jersey shore, and if the desired improvement were made there is no assurance that local interests would provide the necessary connections with the wharves. Under present conditions the commercial development along the shore is not sufficiently advanced or so located as to warrant the construction of the channel now proposed. The board therefore reports that in its opinion it is not advisable for the United States to undertake the work.

4. After due consideration of the above-mentioned reports, I concur in the views of the Board of Engineers for Rivers and Harbors and therefore report that the improvement by the United States of Delaware River from mouth of Cooper River to Fishers Point Dike, on the New Jersey shore, is not deemed advisable at the present time.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
October 17, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. The following is in review of the district officer's reports authorized by the rivers and harbors act of March 4, 1915, on preliminary examination and survey of Delaware River, from the mouth of Cooper River to Fishers Point Dike on the New Jersey shore, including consideration of any proposition for cooperation on the part of local interests.

2. The waterway under consideration lies between Petty Island and the water front of Camden. The mean tidal range is about 5.3 feet. Fishers Point Dike extends from Fishers Point 4,500 feet toward the head of Petty Island, its crest being 2 feet above mean high water. Originally an opening was left between the end of the dike and the island about 2,000 feet in length. Later this opening was partially filled by depositing dredged material up to about low water on line of the dike, leaving a full-depth opening of only 300 feet. The dike was constructed for the purpose of securing an increased flow through the main channel of the Delaware to the west of the island to aid in the improvement of that channel. Since the dike was built a navigable channel has been available between Petty Island and the New Jersey shore, about 12 feet deep through the gap and 12 to 15 feet deep elsewhere. Some shoaling has occurred, particularly near the New Jersey shore, and riparian owners attribute this to the existence of the dike. There is no project for the improvement of this waterway.

3. The improvement generally desired appears to be a channel 15 feet deep at mean low water and 300 feet wide from Fishers Point Dike to Cooper River, with some widening of the gap through the dike. The increased width of opening in the dike is desired in order to secure a greater flow through the waterway with its attendant scouring effect, and to permit tows of barges to pass through more readily at all stages.

4. The present water-borne commerce is not extensive, and it is impracticable to give the amount that will be affected by the improvement. Riparian owners claim that they suffer an annual loss of about $35,000 through insufficient depth of channel.

5. The district officer presents a plan of improvement which provides for a channel 15 feet deep at mean low water and 300 feet wide, with an opening in the dike 800 feet wide, at an estimated cost of $72,875, and $2,500 annually for maintenance. He thinks the locality worthy of improvement to this extent, but recommends that no work be done until the city of Camden has secured and opened for public use a wharf suitable for vessels capable of navigating the proposed channel. The division engineer calls attention to the fact that a depth of 12 feet and even 15 feet with sufficient width now exists generally along the proposed channel, and that the project does not seem to afford the relief really desired, which is increased

depth near the shore. He sees no reason at present for dredging in the channel between Petty Island and the mainland, but he concurs in the recommendation of the district officer that the opening in the dike be cut to a width of 800 feet and a depth of 15 feet at an estimated cost of $33,000.

6. In connection with its investigation of this subject the board made an examination of the locality and held a public hearing in the city of Camden on September 20, 1916.

7. It will be seen from the map of survey that there is now a channel of not less than 12 to 15 feet in depth and of navigable width approximately along the line of the proposed improvement. Little use is made of this channel, apparently, because it is quite a distance from the New Jersey shore and not connected with the wharves and industries by auxiliary channels. These connections which do not now exist would have to be made by the interests concerned before an enlarged channel could be used, and there is no assurance that this would generally be done. A few of the interests concerned have stated that they would do such work as was necessary to make use of the better facilities if provided, but there is no concerted movement in this direction. It was stated, however, at the hearing that the harbor commissioners of Camden had passed a resolution that a public wharf should be built at the site of the old waterworks as soon as a waterway was provided.

8. The dike has served the purpose for which it was built, and the board believes that it would be unwise to disturb the present favorable conditions by diminishing the flow in the main channel. Moreover, it is doubtful whether the opening proposed would result in any very material betterment of channel conditions east of Petty Island. It is believed that even with the improvement proposed considerable periodical dredging would be required to secure and maintain an enlarged channel. A larger opening through the dike would make navigation easier and more convenient for the occasional commercial boats and tows that go through, or would go through if the improvement were made, but the number of these is quite small. Ordinary motor boats can now pass through without difficulty.

9. Under present conditions the commercial development along the shore is not sufficiently advanced or so located as to warrant the construction of the channel now proposed. The board therefore reports that, in its opinion, it is not advisable for the United States to undertake the improvement of Delaware River from the mouth of Cooper River to Fishers Point Dike at the present time.

10. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects which could be coordinated with the project proposed in such manner as to render the improvement advisable in the interests of commerce and navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF DELAWARE RIVER FROM MOUTH OF COOPER RIVER TO FISHERS POINT DIKE.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., September 21, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Delaware River from mouth of Cooper River to Fishers Point Dike.

1. In accordance with instructions contained in letter from your office dated March 15, 1915, the following report is submitted of a preliminary examination of Delaware River from mouth of Cooper River to Fishers Point Dike, on the New Jersey shore, including consideration of any proposition for cooperation on the part of local interests, an item contained in section 15 of the river and harbor act approved March 4, 1915:

2. The section of the Delaware River covered by the examination is shown on the accompanying blue print marked "Sheet I,"[1] and also on Sheet 12 of the maps accompanying the report on an examination and survey of the Delaware River, printed in House Document No. 733, Sixty-first Congress, second session. The waterway under consideration lies between Petty Island, an island opposite the city of Philadelphia, Pa., the Fishers Point Dike, which extends from Petty Island to the New Jersey shore at Fishers Point, and the New Jersey shore from Fishers Point to the mouth of the Cooper River, a small stream flowing through the city of Camden, N. J.

3. A survey of this waterway was made by this office in 1900, the results of which are shown on the accompanying map, Sheet I. Since that date no surveys of the locality have been made except a few soundings in 1910 and 1913 in the immediate vicinity of the gap in the Fishers Point Dike, the latter being shown on the accompanying map marked "Sheet II."[1]

4. In 1900 there was a channel, shown by the contours on Sheet I, 12 feet deep and about 400 feet wide, extending through the waterway, connecting it with the improved channel of the Delaware River at both ends, except where it crossed the dike. At the latter place the 12-foot channel was very narrow. In 1913 at the dike there was a 12-foot channel 250 feet wide. Greater depths than 12 feet existed in the waterway at various places, 28.5 feet being found opposite Cooper River, but the greatest continuous depth through the waterway was about 15 feet. In 1913 there was a very narrow channel across the gap in the dike 15 feet deep. The length of the gap, measured at mean low water, was about 2,000 feet.

5. In 1879 the United States Coast and Geodetic Survey made a survey of this locality. At that time there was no dike in existence. That survey showed depths between Petty Island and the New Jersey shore as great as 32½ feet, and a 12-foot channel at the locality of the dike, with a width of 200 yards. The depth of 15 feet existed

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[1] Not printed.

at the lower end of the waterway, but not at the upper end. At that time there were apparently no wharves on the New Jersey shore between Cooper River and Fishers Point, except the Camden waterworks wharf.

6. The waterway under examination is subject to the ebb and flow of the tide throughout its entire length. The average rise and fall of the tide is about 5.3 feet, and the average tidal currents about 1.4 miles per hour. These currents carry with them some sediment originating in the Delaware River above and below this locality, which, it is claimed by riparian owners, has been deposited in large quantities along the New Jersey shore since the Fishers Point Dike was built. Ice forms during the winter months in this waterway, and sometimes closes it to navigation. Freshets in the Delaware River and unusual tidal conditions sometimes raise the water surface to a height of 10 feet above mean low tide, and, on the other hand, the water surface sometimes falls to 3 feet below mean low tide.

7. No work of improvement has been done by the United States for the benefit of this waterway, except some dredging in the gap in the dike, which will be described later.

8. In August, 1885, in accordance with the recommendations of a board of Engineer officers contained in report dated January 23, 1885 (Annual Report Chief of Engineers, 1885, p. 822), work was started by the United States on the Fishers Point Dike. The approved plan provided for a dike, beginning at Fishers Point and extending for a distance of 3,000 feet toward Petty Island, thus leaving a gap of 3,500 feet between its lower end and the head of Petty Island (Annual Report Chief of Engineers, 1886, p. 820). The top of the dike was to be at the elevation of mean low water. The purpose of the dike is explained in the report of the board, as follows:

> * * * The board concluded that an increased tidal flow through the west channel near the head of the island, sufficient to secure the increased depth and width required, could be procured by building a deflecting dike, starting from Fishers Point and running downstream in a slightly curved direction sensibly parallel with the pier line of the Pennsylvania shore, opposite, extending toward the head of Petty Island as far as might be necessary for the purpose of diverting into the west channel a considerable part of the ebb tidal volume now passing down the east channel.
>
> When this dike shall have extended sufficiently to produce the necessary scour in the west channel it should stop.
>
> * * * * * * *
>
> The works designed for this locality will leave the channels on both sides of the island open, and will probably benefit that on the west side without doing injury to that on the east side.

The board thought that a depth of 12 feet would be sufficient for the wants of commerce. The approved project for the improvement of the Delaware River in this locality is 12 feet.

9. The construction of the dike met with great opposition from various interests in the city of Camden, N. J., and an injunction was issued against the contractors to stop the work, based upon the issue that the dike would destroy the navigable channel and injure Cooper River and the Camden city waterworks, etc. The case was heard before the United States circuit court in New Jersey, which dissolved the injunction. The board of Engineer officers was reconvened in Philadelphia and held a public hearing. The board's

second report (Annual Report Chief of Engineers, 1886, p. 823) states:

> After careful consideration of the subject, the board can not bring themselves to view these objections in the serious light in which they seem to be regarded by the gentlemen who presented them; and it appears to be more than probable that much of the importance which has been attached to them has arisen from the belief that the contemplated dike was to be (as was erroneously stated in the information laid before the chancellor of the State of New Jersey, upon which an injunction was obtained) a solid high-water dike extending from Fishers Point to the head of Petty Island, completely closing the channel. On the contrary, the proposed dike is to be a low-water dike over which the tide will ebb and flow partially, and it is to extend only about half way across the opening between Fishers Point and Petty Island.
>
> It is probable that in the cove formed between this dike and the mainland a deposit will take place which may finally result in filling it up, and in this way the brickyard and other property may be affected, but whether favorably or unfavorably only time will determine.
>
> It is not believed, however, that the work proposed will reduce the volume of water which now passes through the New Jersey channel to such an extent as to affect injuriously any of the other interests referred to.
>
> Should the time ever arrive when, through changes in the regimen of the river, it would become necessary to close this channel completely in order to preserve the main channel, some of the evils now feared might follow, but this is a distant contingency, and in the event of the occurrence Congress would doubtless be willing to afford relief for the local damage which the general interests of commerce and navigation may have made it necessary to inflict.
>
> It does not appear to the board that there are any other means available of successfully maintaining the requisite channel depth in this part of the Delaware River than those which they have heretofore proposed, and they recommend, therefore, that the construction of the Fishers Point Dike be continued and completed.

10. The work was accordingly continued, but in 1888 and 1889 the original plans were modified so that when the dike was completed in 1890 it consisted of a section built of stone and gravel extending 3,500 feet from Fishers Point, and an additional section 1,000 feet long built of piles and stone, both sections having a top elevation of 2 feet above mean high water. The distance from the end of the dike to the head of Petty Island was about 2,000 feet. (See map facing p. 870, Annual Report Chief of Engineers, 1890.) Since 1890 no work has been done on the dike except the deposit, up to 1899, of about 153,500 cubic yards of hard material removed from Smiths Island in Philadelphia Harbor, between the head of Petty Island and the end of the dike. With the exception of a gap 300 feet wide, this deposited material almost closed the opening to the low-water level. (Annual Report Chief of Engineers, 1899, p. 1333.) The channel of the river above Petty Island was dredged in 1896 and 1897 to 26 feet as far as Fishers Point (see Annual Report Chief of Engineers, 1897, p. 1205) in connection with the improvement of the harbor of Philadelphia. For a number of years afterwards annual examinations showed a depth of 26 feet. The latest survey, that of 1909, shows that over a considerable area of the dredged channel the depths were about 21 feet.

11. In April, 1910, the U. S. dredge *Hell Gate* dredged a channel 12 feet deep at mean low water and 300 feet wide between the upper end of Petty Island and the Fishers Point Dike to connect the main channel with the channel east of Petty Island and afford access to the Camden, N. J., water front, as provided in the project for the improvement of Delaware River, Pa., and N. J., from Allegheny

Avenue, Philadelphia, Pa., to Lalor Street, Trenton, N. J. This project is contained in House Document No. 702, Sixty-first Congress, second session, and reference to the dredging just mentioned will be found on page 21 of that document, as follows:

> The dike at Fishers Point has been very successful. When this dike was constructed an opening was left between the dike and Petty Island to afford access to the Camden water front in that vicinity. Complaint has been made recently that this opening is obstructed. A small amount of work should be done to clear this opening, but the work is not of sufficient amount to appear as a separate item in the estimate.

Since 1910 no work has been done in the vicinity of the dike, and the exact condition of the channels north and south of the dike is not known.

12. No harbor lines have been established by the War Department in this waterway. The Riparian Commission of the State of New Jersey has, however, established, at various times, "exterior wharf lines" and "lines for solid fill," as shown on the accompanying chart marked "Sheet III."[1] The riparian commission has also granted certain riparian rights by lease and sale, to riparian owners, which are also shown on Sheet III. This sheet also shows the names of the riparian owners.

13. The commercial conditions of the waterway are most conveniently shown by describing the conditions existing at each piece of property along the water front, beginning at Cooper River and proceeding upstream.

(a) The *Petty Island shore* is entirely undeveloped.

(b) *Moro Phillips estate.*—This is an extensive tract of undeveloped land, with a frontage of over 2,000 feet. The estate has expressed no direct interest in any improvement of the adjacent channels, except to express the belief that land values would be increased by such improvement.

(c) *City of Camden waterworks.*—No commercial use is made of this water front. It is proposed to improve this wharf and open it to public use. See paragraph 19 of this report.

(d) *M. P. Howlett*, commission merchant, operates a fleet of fishing boats in Delaware Bay and elsewhere. He uses his property for the repair of boats and for building scows. He states that his dock is rapidly becoming unfit for use by reason of shoaling, which occurs at the rate of a foot a year, and he believes that the shoaling is caused by the Fishers Point Dike. His annual loss in increased cost of handling materials and in time lost waiting for tides is placed at $5,000. He believes that the channel through the dike should be widened to 400 feet and deepened to 15 feet at mean low water.

(e) *Peter Hagan.*—This is a ship repair yard, frontage 460 feet, formerly employing 15 to 25 men and doing an annual business of $25,000. The plant is now idle and in the hands of receivers. Mr. Hagan attributes his failure to shoaling in this part of the river.

(f) *Philadelphia Brewing Co.*—A frontage of 240 feet, unimproved, except as an amusement park. The company has no interest in channel improvement.

(g) *Frederick McOwen.*—Unimproved, and not used for commercial purposes.

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[1] Not printed.

(*h*) *Wilson Rickenbach* has a shipyard in which lighters, etc., are built. He uses 600,000 to 750,000 feet of lumber per year, which must be removed by rail instead of by water because of insufficient depth in the adjacent waterway. He estimates his annual loss in increased freight costs at $4,500, and believes that with deeper water the business could be increased $10,000 to $15,000 yearly. *James Rickenbach* rents space from Wilson Rickenbach for the building of lighters and scows. Part of his lumber and other materials is teamed to his plant at an increased cost over direct water rates of $4,200 a year. He believes that with improved water-front conditions his business could be increased $7,000 to $8,000 per year.

(*i*) *Smith & Sinclair* (not shown on Sheet III) located at the foot of Twenty-seventh Street, are engaged in the manufacture of heavy machinery, boilers, engines, brass and steel castings, etc., for tugs and other boats. They employ from 15 to 25 men. Their water front is bare at low tide, and some shipments must be teamed to the railroad or direct to consignee, teaming being less expensive than lightering. Freight costs are thus increased 50 per cent over what they would be if cargoes could be received and shipped by water without lightering. Some tugs desiring to come to this plant for repairs can not reach the wharf even at high water. All fuel used in the yard is teamed three-quarters of a mile from the railroad. The building of a marine railway, which was also planned by this firm, has been abandoned until deeper water can be secured. The amount of business lost annually because of the shoal water front is estimated at $7,500 to $8,000.

(*j*) *Noecker & Ake Shipbuilding Co.*, frontage 517 feet, is located between Twenty-seventh and Twenty-eighth Streets. This is said to be the second largest shipyard in Camden, employing about 300 men. They report having repaired in one year 804 vessels, including tugs, lighters, river and seagoing barges, dredges, and schooners, draft from 2 feet to 14 feet. They have a pier over 400 feet long, built 15 years ago. At that time the depth at the outer end was 9 feet at low water. The present depth at the end and for about 200 feet beyond the pier is about 2 feet at low water. In the past 10 years from $6,000 to $8,000 have been spent in dredging this water front to a depth necessary to do business. The company uses 1,500,000 to 2,000,000 feet of lumber annually, which is brought to Philadelphia by the Southern Steamship Co., and must be lightered to the yard, at a cost of $250 to $300 per 100,000 feet. The freight cost on lumber is thus increased $12,000 a year beyond what it would be if shipments could come direct to the wharf without lightering. Machinery and other heavy materials must come by rail and be teamed three-quarters of a mile, from Pavonia Station, at an annual cost in freight charges $2,100 in excess of the rate by water. The firm states that shoal conditions have caused them to lose repair work from the John H. Gerrish Dredging Co., of New York, worth $4,000 to $6,000, and a contract for a dredge from the Atlantic, Gulf & Pacific Co. The loss in wharfage charges that could be earned with sufficient depth of water is placed at $2,500 a year. The total annual loss suffered by this company from the shoaling of the channel and water front in increased freight rates, teaming, dredging, loss of wharfage, and contracts, is estimated at $24,100. They desire to secure and maintain a depth of 12 feet at mean low water at the end of their slips. A brief inspection of this plant on August 6, 1915, showed all available docking space occupied by boats of various kinds, from scows to a side-wheel steamer, under construction or being repaired. A member of the firm stated that they are very busy at present.

(*k*) The *North Cramer Hill Ferry Co.* (not shown on Sheet III) owns a pier at the foot of Twenty-eighth Street, from which for 20 years it has operated a ferry to Susquehanna Avenue, Philadelphia. Since this pier was built the water front has shoaled so that the depth is now 5 feet at low tide, where formerly it was 12 feet. The shoaling is attributed to the action of the Fishers Point Dike. Capt. Morgan, of the ferry company, states that before the dike was built all upriver traffic used the channel east of Petty Island, which could be easily navigated by boats drawing 16 feet. The company estimates its annual loss to be $2,600, due to the business depression along the North Camden water front caused by the shoaling. Another partner of this company stated on August 6, 1915, that business conditions in this section of Camden seem to be improving somewhat, and that they are carrying a larger amount of freight to the shipyards.

(*l*) *Bernard Tucker* owns a shipyard, frontage 200 feet, between Twenty-eighth and Twenty-ninth Streets, which has built, since 1899, 14 lighters, 1 seagoing barge, and 2 seagoing tug boats, costing altogether about $200,000. Nearly all materials used in this work (about 30,000 tons) were received by water, at excessive cost by reason of lighterage charges. The freight on a water shipment of lumber for a number of houses which Mr. Tucker built near his shipyard, it is stated, was 100 per cent greater than it would have been if the lumber could have been landed without lightering. In 1906 a wharf was built on this property, having at its outer end a depth of 9 feet at low water. On account of the dike at Fishers Point this depth has since shoaled to 1 foot at low water, and the shoal extends 200 feet beyond the wharf. Where the bottom along shore was formerly of gravel there is now 3 or 4 feet of mud. The annual loss at this plant, due to present water-front conditions, is estimated at $8,000. With deeper water the business could be increased $6,000 to $10,000. Mr. Tucker thinks the channel should be dredged to 12 feet at mean low water, and enough of the Fishers Point Dike removed to maintain this depth.

(*m*) *Dempsey & Sons* have a shipyard between Twenty-ninth and Thirtieth Streets; frontage, 217 feet. They are also engaged in the transportation and lighterage business. In 1907 the yard was equipped for building steel vessels, and two steel barges, capacity 1,000 tons each, were built that year. The rapid shoaling, however, compelled the firm to discontinue building large boats, and the yard is now used only for repairs to their own vessels. The water front is now bare at low tide for 30 feet beyond the end of the wharf, and the depth at the exterior wharf line is now 4 feet at low water where formerly it was 10 feet. Lack of water at their dock compels the firm to tie up some of their boats at other wharves, at an annual cost of $8,000. The shoaling is attributed to the action of the Fishers Point Dike. This dike is an additional detriment to the firm, as they claim the channel through the gap is poorly marked, and in consequence their tows have grounded on the submerged rocks. Their tug captains now refuse to attempt this channel and go around the lower end of Petty Island. The longer tow is estimated to cost, at the rate of 8 or 10 tows a week (which is considered the average number), $3,000 a year. Under improved conditions the firm expects to build another wharf and reopen their iron shipbuilding plant.

(*n*) *W. S. Kirk* owns 100 feet of frontage at the foot of Thirtieth Street. There is a small wharf used for pleasure boats. No commercial use is made of this property.

(*o*) The *American Dredging Co.* owns an extensive frontage (976 feet on the exterior wharf line) between Thirtieth and Thirty-second Streets, which is unimproved at present. At one time the company considered building a pier here, but shoaling of the channel and water front caused them to abandon the plan. It is the opinion of this company that enough of the submerged part of the Fishers Point Dike should be removed to make an opening corresponding in width to the distance (about 800 feet) between the riparian lines along the New Jersey shore and those along the south side of Petty Island, and a channel dredged from this opening to Cooper River 15 feet deep at mean low water and 400 feet wide, with its easterly edge adjacent to the New Jersey riparian commissioners' exterior wharf line. It is also urged that the Government adopt these riparian lines as pierhead lines.

(*p*) The *Craemer Wrecking Co.* (not indicated on Sheet III), owning about 300 feet of frontage near Thirty-second Street, is engaged in raising wrecks and also in dismantling these and other old boats for junk. It is not possible to break these boats up as fast as they are acquired, and the result is that this water front is filled with numerous hulks in various stages of disintegration. Mr. Craemer has no interest in any improvements proposed for this locality, for the reason that if such improvements are realized, the other interests will find this "graveyard of ships" a nuisance, and will want him to get out.

(*q*) *T. L. Bear* owns about 1,100 feet of frontage, mainly unimproved, between Thirty-third and Thirty-sixth Streets. Some years ago Mr. Bear built a wharf at the foot of Thirty-sixth Street, costing $7,500. At that time the depth at the end of the wharf was about 10 feet at low water. The present depth at the wharf is 18 inches. This wharf is no longer used and is in bad repair. There are a few other small piers and floats along this water front used by pleasure boats.

(*r*) *Sparks estate.*—This property has a frontage of 1,800 feet, part of which was formerly occupied by a woolen mill. It is stated that the shoaling of the water front and approaches compelled the firm to suspend business. Subsequently another party leased the mill for a wool cleaning and dyeing establishment. A few years ago the plant burned out and has not since been rebuilt. The mill is now in ruins, and the wharf has nearly disappeared. The rest of this frontage is not used for commercial purposes.

(*s*) Above the Sparks estate are the Mozart Fishing Club, frontage 200 feet; a considerable frontage occupied by the right of way of the Pennsylvania Railroad, Camden and Trenton branch; and some other properties. None of these frontages are used for commercial purposes.

(*t*) *Atlas Cereal Co.*—This firm owns a frontage of about 316 feet, measured on the wharf line, at Fish House, N. J. Their riparian grant runs to the Fishers Point Dike. Mr. Sheppard, of this company, states that no shipments by water have ever been made, although the factory was built over the water on piles to afford wharfage facilities in case rail rates proved exorbitant. The railroad charges, however, have always met the views of the firm and the wharf has not been used. Since February, 1915, this plant has been idle, owing to competition in the manufacture of starch, and is now for sale. Mr. Sheppard further states that he has not observed any shoaling in the cove opposite his property during the last five years. There are flats bare at low tide midway between the dike and the New Jersey shore, but the tidal action appears to be sufficient along the shore to maintain the present depths. The current is observed running down stream past this wharf during flood tide and upstream during ebb tide, owing to the action of the dike and the curving of the shore at the head of the cove. The depth at the end of the wharf is about 2 feet at mean low water.

(*u*) *Augustus Reeve.*—This property is located at Fish House, N. J., just above the Atlas Cereal Co. Frontage, 780 feet. It was formerly the site of a brickyard. Nothing remains of this plant but a chimney, as the clay deposits gave out 15 years ago, and it has since been idle. The owner states that he has been unable to sell the property because of the shoaling of this part of the river.

(*v*) The *Hatch Brick Works*, above Fish House, has a frontage of 936 feet on the old exterior wharf line. This plant is now running and bricks are shipped by water only to Camden, Philadelphia, and other Delaware River points. The depth at the wharf is about 6 inches at low water, and all traffic must be handled on the high tide. The annual towing bill is now $2,000. With deeper water this could be reduced one-half. The rate on coal in scows is now 17 cents a ton. Deeper water would allow these scows to be loaded deeper, which would probably reduce the freight charges.

(*w*) The *Pennsylvania Railroad Co.* owns frontage at the head of the cove below Fishers Point. This is natural river bank, unused for commercial purposes.

(*x*) The *city of Camden* claims ownership of a number of the street ends between Twenty-fifth and Thirty-sixth Streets. The matter has not yet been settled by the courts.

14. The railway lines nearest to the waterway are shown on Sheet III.

15. As shown above, local opinions differ considerably as to what form of improvement is desired. At a meeting held in this office on April 30, 1915, at which various interests were represented, the general opinion was that all parties would be satisfied by a channel 15 feet deep at mean low water and 300 feet wide, extending from Fishers Point Dike to Cooper River along the Camden wharves; that the present gap in the dike should be widened to 1,200 feet, with a depth of 15 feet; and that the remainder of the submerged portion of the interval between the end of the present dike and Petty Island should be raised to an elevation a few feet above mean high water. The purpose of widening the gap was not only to permit a greater flow of water through the waterway, but to permit tows of barges to pass through readily at all stages of tides and tidal currents, and

that of elevating the submerged part was to permit pilots to readily distinguish the ends of the gap.

16. It has been shown in paragraph 13 above, from the statements of commercial interests, that a deeper channel would be of considerable value to them. The channel desired can be readily secured by a comparatively small amount of dredging. If any great amount of shoaling has taken place since the dike was constructed, and this fact can be established positively only by means of a survey, it is clear that an increased width of opening in the dike will aid in the maintenance of a deeper channel than that now existing. Moreover, a somewhat wider opening will not result in any serious injury to the main channel in the vicinity of the dike, which channel is now about 25 feet deep and much deeper than the approved project depth for that portion of the Delaware River. It is my opinion that an opening having a width of 1,200 feet is not required, and that a lesser width, say 800 feet, will be sufficient, and there may be sufficient material along the line of the dike to provide such an opening and raise the remaining portion to the required height. The proposed improvement should not, therefore, be excessively expensive.

17. It is my opinion that this waterway is worthy of improvement to the extent mentioned in paragraph 16 above, and I have therefore to recommend that a survey be made to determine its cost.

18. There are no questions of water power, drainage, etc., connected with this waterway.

19. The question of cooperation on the part of local interests with the United States in the improvement of the waterway now under consideration was taken up with the mayor of the city of Camden and the board of harbor commissioners. The latter body has extensive powers under its charter to make improvements along the Camden water front, and by virtue of its authority passed a resolution (copy attached) to make improvements to the river end of Twenty-fifth Street (the old Camden city waterworks) by building a wharf both for recreation purposes and for the accommodation of boats to both load and unload. The effect of this resolution will be to provide a public terminal for the handling of various descriptions of commodities, and therefore represents a valuable form of cooperation.

Geo. A. Zinn,
Colonel, Corps of Engineers.

[First indorsement.]

Office of Division Engineer, Eastern Division,
New York City, September 27, 1915.

To the Chief of Engineers, United States Army:

Concurring in the views and recommendation of the district Engineer officer.

W. M. Black,
Colonel, Corps of Engineers.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
October 12, 1915.

To the Cheif of Engineers, United States Army:

1. For reasons stated herein, the board concurs with the district officer and the division engineer in recommending a survey in order

to determine the extent and advisability of the improvement. In view of the wording of the law it is desirable that further investigation be made as to possible cooperation on the part of local interests. A comparison of the depths existing in the river east of Petty Island before the construction of the Fishers Point Dike with present conditions is also desired by the board.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member Present.

LETTER OF THE SECRETARY OF THE BOARD OF HARBOR COMMISSIONERS.

CAMDEN, N. J., *September 17, 1915.*

SIR: At the regular meeting of the board of harbor commissioners of the city of Camden, held September 8, the following resolution was adopted:

Whereas the improvements contemplated by the upper Delaware River shore will fill a long felt want and enhance the facilities for safe navigation; and

Whereas the deepening of the channel and the removal of the stone pile will open the way for industrial development to an extensive degree; and

Whereas it is the duty of the municipality to give substantial aid in every undertaking that tends to bring more manufactories and otherwise better industrial conditions; Therefore be it

Resolved, That the board of harbor commissioners of the city of Camden hereby declares its intentions to make improvements to the river end of Twenty-fifth Street by the building of a wharf both for recreation purposes and for the accommodation of boats to both load and unload; and be it

Resolved, That provision for said improvement be made in the budget estimate which this board presents to city council.

Respectfully,

JOHN H. DONAHOO, *Secretary.*

Col. GEORGE A. ZINN,
Corps of Engineers.

SURVEY OF DELAWARE RIVER FROM MOUTH OF COOPER RIVER TO FISHERS POINT DIKE.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., April 18, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Survey of Delaware River from mouth of Cooper River to Fishers Point Dike.

1. In compliance with the instructions contained in department letter of October 22, 1915, the following report is submitted on the survey of Delaware River, from mouth of Cooper River to Fishers Point Dike, on the New Jersey shore, including the consideration of any proposition for cooperation on the part of local interests, as authorized by the river and harbor act, approved March 4, 1915.

2. The survey was made in November, 1915 (3d to 22d), and cost about $500. The soundings covered the entire river on both sides of Petty Island from the railroad bridge to Cooper Point. The triangulation was joined to monuments marking the harbor lines from Cooper Point to Newton Creek. No base line measurement was required. Topography of the shore line was located by instruments, except in minor instances, where it was traced on existing maps.

3. The results of the survey are shown on the map herewith, marked "Delaware River, Cooper River to Fishers Point, sheet No. 1." There are also inclosed herewith a blue print[1] made from the tracing just mentioned, on which have been placed the contours of the river bed as shown in a survey made by the United States Coast and Geodetic Survey in 1879, and three tracings[1] showing cross sections of the channel surveyed as they now exist, as they existed in 1879, and of the proposed channel improvement.

4. A report upon the preliminary examination of this section of the Delaware River was submitted by this office under date of September 21, 1915. In paragraphs 15 and 16 of that report it was stated that a channel having a depth of 15 feet and a width of 300 feet, with an opening in the dike, diagonally across the channel, 800 feet wide, would satisfactorily fulfill the needs of commerce. The channel thus described is indicated on the tracing herewith (sheet No. 1), and has been laid out in such a way as to reduce to a minimum the amount of dredging required to secure it. It is to be noted, however, that the above-described channel between the points mentioned in the law, viz, Cooper River and Fishers Point Dike, will be of vastly greater benefit to commercial interests if continued southward from Cooper River to the main channel of the Delaware River, and northward from Fishers Point Dike to the main channel of the river. In fact the channel indicated in the law would be of almost no benefit unless it is joined to the main channel of the Delaware above and below Petty Island. It is estimated that the quantity of material required to be removed to secure the above-described channel and the cost of removal is as follows:

Cooper River to Fishers Point Dike, including approach between dike and main channel, 235,000 cubic yards (scow measurement), at 25 cents	$58,750
Cooper River to main channel below Petty Island, 30,000 cubic yards (scow measurement), at 25 cents	7,500
Engineering, superintendence, and contingencies	6,625
Total	72,875

5. Borings were not made to determine the character of the material to be removed by dredging for several reasons, but mainly because the proposed channel lies wholly within the natural channel as it existed in 1879, and the shoaling which has taken place since that year has been caused by the deposit of mud and sand brought there by tidal currents and freshets. There is practically no probability that gravel has been deposited in that vicinity by the river currents. The material to be removed from the line of the existing dike was deposited there some years ago during the dredging operations in the main channel of the river opposite Philadelphia, and is composed of larger and heavier particles than that found in the channel back of Petty Island. It is believed that the assumed cost, viz. 25 cents per cubic yard, is ample to cover the cost of dredging of this latter material and of placing it on the dike.

6. It is difficult to forecast the amount of shoaling which will take place annually after the proposed channel shall have been dredged. It may be anticipated that the effect of increasing the width of open-

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[1] Not printed.

ing in the dike will increase the quantity of water flowing through the dike, with a consequent reduction in the amount of shoaling which takes place under existing conditions. A comparison of the cross sections on sheets 3, 4, and 5 shows very plainly that since 1879 the channel east of Petty Island has shoaled throughout its entire length. If the Fishers Point Dike were to be entirely removed, there is no doubt that this channel would be eroded and restored to its former depth, with, however, an equivalent injury to the channel west of Petty Island. It is my opinion that it will be safe to assume an annual deposit of 10,000 cubic yards, which will cost about $2,500 to remove.

7. The commercial conditions of this waterway were fully described in paragraph 13 of the preliminary examination report, and no additional information has been secured. It was shown in that report by statements of occupants and owners of riparian property that the annual loss to them due to an insufficient depth in the channel was in the neighborhood of $35,000. If these statements have a reasonable basis of truth, it is evident that an expenditure of $72,875 for the first cost of the improvement and an annual expenditure of $2,500 for maintenance is amply justified. It is my opinion that the above-described channel is therefore worthy of improvement in the manner and to the extent above mentioned.

8. A further effort has been made to determine the extent to which the city of Camden would cooperate with the United States in securing the desired improvement and providing public terminal facilities. Copies of correspondence on this phase of the matter are herewith marked "Appendix A" and "Appendix B," from which it appears that the city of Camden has not as yet guaranteed any assistance whatever, and I have to recommend that no work of improvement on the Delaware River, from the mouth of Cooper River to Fishers Point Dike, or on the channel east of Petty Island, be undertaken until the city of Camden has actually secured and opened to public use for freight-transfer purposes a wharf lying within the boundaries of the above-described channel and suitable for use by freight and passenger-carrying vessels capable of navigating the said channel.

9. The quantity of material to be removed, namely, 265,000 cubic yards, and its character indicate that one good dredge can remove it all in a period of less than three months, which is less than the period of one working season in the Delaware River. The funds required for the work should therefore all be appropriated in the initial appropriation and the work should be prosecuted continuously from inception to completion.

GEO. A. ZINN,
Colonel, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, EASTERN DIVISION,
Baltimore, Md., June 1, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The recommendation is concurred in that any improvement of the channel behind Petty Island shall include adequate approaches above and below the island to the Delaware River.

2. From the preliminary report it appears that the Fishers Point Dike was completed in 1890 a distance of 4,500 feet from Fishers Point with a top elevation of 2 feet above mean high water. The distance from the end of the dike to Petty Island was about 2,000 feet.

3. In 1899 about 153,500 cubic yards of hard material, removed from Smiths Island, in Philadelphia Harbor, was placed on the line of the dike between the dike and the head of Petty Island. This deposit had a general elevation of about low-water level, with a gap about 300 feet wide.

4. There is nothing found in the various reports discussing the reasons why this material was placed between Petty Island and the dike. The report of the district engineer officer, 1899, states that it was difficult to find dumping grounds, but does not discuss the effect on either the main channel or Petty Island Channel. This report states, page 1336, that the area of cross section of the latter channel had decreased from 30,147 square feet to 24,494 square feet between 1878 and 1898, the main channel having increased over 50 per cent. The average depth had decreased from 13.4 to 13.3 feet. In 1900 the Petty Island Channel had a continuous depth of not less than 12 feet and 400 feet width, except at dike, where it was much narrower. The effect of the dike on the main channel has been beneficial, and the fact that even with the dike there has been considerable shoaling in the main channel near this point indicates that it would probably be detrimental to diminish substantially the flow of water in the main channel.

5. In 1910 a channel 12 feet deep at mean low water was dredged through this gap between Fishers Point Dike and Petty Island.

6. A comparison of the map made by the Coast and Geodetic Survey in 1879 with that of this survey shows that the channel behind Petty Island has filled very largely. This is doubtless due to the dike. This filling is both a general shoaling over the entire channel back of Petty Island and the building out of the flats on both sides of the channel. It will be noted, however, from the preliminary report (par. 5) that there was only a channel 12 feet deep and 200 yards wide at the head of the island before the dike was built. Also, from the map, that flats existed in 1879 along both sides of the channel, extending with shallow depths a considerable distance from the shore. The filling since construction of dike has been largely on the Petty Island side, where it is more or less unobjectionable, and, except at the upper end of the channel and behind the dike, it would appear that a slight extension of the wharves along the mainland front would bring about almost as good conditions for navigation for a depth of 10 or 12 feet as before existed. The bringing of shallow-draft boats to the shore is, however, made more difficult.

7. There is apparently no project for the improvement of this channel, nor is it connected with the projects for any other parts of the Delaware River, except in a minor degree, by being alluded to in report in House Document No. 702, Sixty-first Congress, on improvement of Delaware River from Allegheny Avenue, Philadelphia, to Lalor Street, Trenton, and some work was done in 1910

(preliminary report, par. 11). As Fishers Point Dike was built to improve navigation at and below Philadelphia, and from funds appropriated for that object, it would seem proper to include this channel in that project, giving it, if possible, depths appropriate to the commerce that would develop.

8. The project depth of the lower Cooper River and of the upper Delaware is 12 feet, although it should be added that the Delaware River proper along the Philadelphia water front opposite the entrances is over 20 feet deep.

9. It is believed that a low-water depth of 12 or certainly not to exceed 15 feet in the channel should be ample. It will be noted that except at the dike crossing a 12-foot and even a 15-foot depth, with sufficient width, exists generally along the channel laid out by the district Engineer officer with good connection with the main river at the lower end.

10. Passage through the dike is said to be dangerous by vessels, especially with tows, for the reason that part of the dike being built only to low water it is difficult to keep boats off the ends. This is, from personal examination, believed to be the case, and a wider opening with the jetties built up to above high water is deemed advisable. Whether this will cause deepening of the Petty Island Channel is somewhat a matter of conjecture. More water will go through the opening, but the passage of water over the remainder of the dike between high and low water will be stopped. The concentration of the flow may affect the channel for a short distance below the opening.

11. A reading of the testimony of the various property owners along the Camden front would indicate that they considered not that the channel itself was not deep enough, but that it was too shallow near their docks. While the district Engineer officer had in view, in his discussion and hearing, the boat channel itself, it seems evident to me that the loss of $35,000 a year, stated to be experienced by these owners on account of deterioration of channel, could not apply to the channel proper, as that would seem to have been ample for ordinary purposes, but that it is attributed by them to the shoaling in the vicinity of the shore.

12. The project submitted by the district Engineer officer does not seem to me to afford the relief really desired; that is to say, increased depths near the shore. It is doubtful whether such relief could be obtained except at undue cost. It is practically impossible to prevent the filling behind the dike except at an expense which would not be warranted. The dredging or forcing of a channel near the docks would be costly, probably only temporary, and should be carried out by the dock owners.

13. I concur in the recommendation of the district Engineer officer that the opening of the dike be cut to a width of 800 feet and a depth of 15 feet, building the new part of the dimensions stated. The depth of 15 feet is taken so as to give a greater tidal flow and also because it seems desirable to obtain a channel sufficient for possible future need. The district Engineer officer informs me that there will be sufficient material dredged at the point to make the dike of the dimensions proposed, and that in his opinion the material is of such nature as to make a permanent structure.

14. I do not think that there is any reason at present for further dredging in the channel between Petty Island and the mainland while awaiting the effect of this change in the jetty. I also recommend that the channel between Petty Island and New Jersey shore be considered, as far as maintenance is concerned, as a part of the project for the improvement of the Delaware River at and below Philadelphia, and that funds appropriated for this maintenance shall be made applicable to the channel between Petty Island and New Jersey.

15. A separate estimate by the district Engineer officer for this work at the dike is 45,000 cubic yards, place measurement, and 60,000 cubic yards, scow measurement, and, on account of the hardness of the material, the cost is estimated at 50 cents a yard, with 10 per cent for engineering and contingencies; that is, $33,000. The material below the dike, being soft, is estimated at 18 cents per cubic yard, so that in his report the district officer averages at 25 cents a cubic yard, being 60,000 cubic yards of the hard material and 175,000 of the soft. This amount of $33,000 is recommended.

John Biddle,
Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors on survey see p. 3.]

Appendix A.

LETTER OF COL. GEO. A. ZINN.

War Department,
United States Engineer Office,
Philadelphia, Pa., November 26, 1915.

Dear Sir: An item in the river and harbor act approved March 4, 1915, authorizes and directs the Secretary of War to cause a preliminary examination and survey to be made of Delaware River, from the mouth of Cooper River to Fishers Point Dike, on the New Jersey shore, including consideration of any proposition for cooperation on the part of local interests.

The preliminary examination has been completed, and a survey of the locality will be made in the near future.

With regard to "any proposition for cooperation on the part of local interests," I am inclosing herewith copy of a resolution passed by the board of harbor commissioners of Camden on September 17, 1915, in which it is stated that "Camden hereby declares its intentions to make improvements to the river end of Twenty-fifth Street, by the building of a wharf for recreation purposes and for the accommodation of boats to both load and unload." Question has been raised as to whether the city of Camden is bound in any way to carry out the resolutions of the board of harbor commissioners, and I therefore wish to inquire whether the city of Camden has expressed its intentions through your committee upon the subject.

It is probable that any improvement of the Delaware River between the mouth of Cooper River and Fishers Point Dike that may be authorized by Congress will be made dependent upon local cooperation, and I am desirous of learning the extent of local cooperation contemplated.

Your early reply will be appreciated.

Very respectfully,

Geo. A. Zinn,
Colonel, Corps of Engineers.

Mr. A. R. Gemberling,
Chairman of the Finance Committee of the
City Council, Camden, N. J.

LETTER OF THE SECRETARY BOARD OF HARBOR COMMISSIONERS.

CAMDEN, N. J., *September 17, 1915.*

HONORABLE SIR: At the regular meeting of the board of harbor commissioners of the city of Camden held September 8 the following resolution was adopted:

Whereas the improvements contemplated by the upper Delaware River shore will fill a long-felt want and enhance the facilities for safe navigation; and

Whereas the deepening of the channel and the removal of the stone pile will open the way for industrial development to an extensive degree; and

Whereas it is the duty of the municipality to give substantial aid in every undertaking that tends to bring more manufactories and otherwise better industrial conditions: Therefore be it

Resolved, That the board of harbor commissioners of the city of Camden hereby declares its intention to make improvements to the river end of Twenty-fifth Street by the building of a wharf both for recreation purposes and for the accommodation of boats to both load and unload; and be it

Resolved, That provision for said improvement be made in the budget estimate which this board presents to city council.

Respecfully, JOHN H. DONAHOO, *Secretary.*

Hon. WILLIAM J. BROWNING, M. C.,
Camden, N. J.

APPENDIX B.

LETTER OF THE CITY COMPTROLLER.

CAMDEN, N. J., *March 28, 1916.*

DEAR SIR: Your communication to Mr. A. R. Gemberling, chairman of the finance committee of city council relative to contemplated improvements to the river end of Twenty-fifth Street, as set forth in a resolution of the harbor commissioners, under date of September 8, 1915, was read to the finance committee at a regular meeting held March 27, 1916, and the city comptroller was instructed to inform you that plans for said improvements are now being prepared, and when completed and the cost of improvements determined it is the intention of the finance committee to provide funds for same.

Very respectfully, yours,

S. P. MCCORD,
City Comptroller.

Col. GEORGE A. ZINN,
Corps of Engineers.

PUBLIC HEARING HELD SEPTEMBER 20, 1916, AT CITY HALL, CAMDEN, N. J., BY THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS, FOR THE CONSIDERATION AND DISCUSSION OF THE PROPOSED IMPROVEMENT OF DELAWARE RIVER FROM THE MOUTH OF COOPER RIVER TO FISHERS POINT DIKE, N. J.

The hearing was called to order by Col. Frederic V. Abbot, Corps of Engineers, United States Army, senior member, Board of Engineers for Rivers and Harbors, at 3 p. m., September 20, 1916, in the council chamber of the City Hall, Camden, N. J.

Col. ABBOT. The meeting will please come to order. The hearing this afternoon is in connection with the following clause in the river and harbor act approved March 4, 1915: "Delaware River, from mouth of Cooper River to Fishers Point Dike on the New Jersey shore, including consideration of any proposition for cooperation on the part of local interests." The hearing has been given in accordance with the notice of Maj. Oakes, dated September 9, 1916, which is here and anyone can see it who wishes to. We will be very glad to hear anyone, but if some one will organize the speakers so that they can present the matter in a logical way it will save time.

Hon. WILLIAM J. BROWNING, M. C. Col. Abbot and gentlemen, we have here some of our representative citizens, especially those interested in this project. We have come before you requesting you to give us what we think are our rights. Some years ago, many years ago, I might say, the New Jersey channel was the deep-water channel in this part of the Delaware River. We had all the vessels passing up and down the Delaware River on our side of the river. Then, when the 30-foot project, or channel, from Philadelphia to the sea, was started they built this dike that is known as the Fishers Point Dike across to Petty Island. At one time it was a solid dike cutting off our river front practically, and almost ruining it. Some years afterwards some 300 feet of stone pile were taken out of that dike, which gave us a shallow channel for getting in there, principally for motor boats. On that river front we have two, if not three, shipyards, and to get to their yards they have got to go down the Philadelphia channel around Petty Island and then up again. To come in through the dike is almost an impossibility, especially with a tow. We have here some of our representative citizens who are interested in this project. They can tell you the disadvantages under which they are now placed and what they want. They all think favorably of this proposition. Col. Zinn gave us a very favorable report, and the city is ready to do their share by dedicating the old waterworks wharf, making it a public wharf. One of the members of the River and Harbor Board is here and he will speak. I am going to turn the matter of calling on these gentlemen over to Mr. Frederick von Nieda, city councilman from the eleventh ward, and also the secretary of the North Shore Improvement Association. He is familiar with the aspects of the case, he represents that district, and the whole river front, which is a very valuable river front, and about all we have left now. Mr. von Nieda will call on these gentlemen to respond.

Mr. **Frederick von Nieda.** Gentlemen, representing the North Shore Improvement Association, in part, I would like to state that when we submitted our figures and our data, which undoubtedly is on file with your honorable board, we were very happy when Col. Zinn was so particular and went into details so minutely, because we felt sure that our plea then could not help but get the proper consideration. We were very much pleased when we read the report of Col. Zinn, and were just as much shocked when we heard the dissent of your board, saying that the present depth of the channel out on the north shore of Camden's water front was adequate for present traffic. It said further that the main difficulty was the shoal water in the wharves and in the approaches, and that it was not warrantable to dig a second channel along the Camden water front of that section. I want to assure you, gentlemen, that we did not and do not now ask for a second channel along the Camden water front. What we do ask for is a channel. Traffic out our way is certainly not as good as we would like it to be, and certainly not what it once was, and is perhaps not as great as we ought to have had long ago, but speaking of the traffic, I might say that water traffic is exactly that which its depth of water will permit it to be, namely, that if we have not got the water we certainly can not get our traffic there. I would like to submit, gentlemen, that this is the case at the present time. We have not got the water; we have not got the traffic. We could have this traffic providing we had the water. I know, and I am positively sure when I say that work at this time in the various shipyards must be turned away for no other reason than that. We are not pleading, gentlemen and Mr. Chairman, for mere pork, but just simply for an improvement in order to get something. What we are pleading for to-day is our very life, our existence; we are asking for the maintenance of the interests that we now have. I feel, and this is the universal opinion of those who are interested in that water front and who know the condition truly, those who have to pay the bills, that unless we receive Federal aid, unless we are going to have help, sooner or later this question of water traffic must cease there. I would like to submit that tugs drawing 10 feet of water at a moderate low tide can not come up in that channel unless they confine themselves to the positive channel that now is there. We have a little channel, as was properly stated, but it has grown very shallow in its approaches. In fact, at this time the very apex of the curve of this channel is possible to travel at low tide, and a variance of several feet will bring any vessel with a draft of 10 feet or more on the mud pile. Furthermore, we want to state that the North Cramer Hill Ferry Co. has the same sort of trouble. I referred a little while ago, when I spoke of tugs, I wanted to say that these are the tugs of the Tucker Co. and the shipyards up there, and their pilots and engineers have told me that at a moderate half tide they have fetched up, and the North Cramer Hill Ferry Co., in wintertime, when the north winds are prevalent and cause unusual low tides, their work was abandoned. They abandoned the entire service.

Water-borne traffic, as we understand it, and as everybody knows, is most profitable when brought in large vessels, and I want to say right now that the four-masters that were once upon a time to be seen back of Petty Island are a thing of the past. Big barges no longer deem it safe to come in there, so consequently we are up against a very ticklish proposition, because as the conditions are now, it means that this traffic that we have had when the depth was adequate for the traffic, it means that this traffic will come in boats of less draft, it means smaller boats and less boats, and, then, gentlemen, I predict inside of 10 years, if conditions remain as they are, we would practically have to say " vale " to the industries of Camden's north harbor. The only thing that might then be possible to operate would be the motor-boat traffic, for which the depth is perfectly adequate to this day, but, of course, motor boats are not the water traffic that we are looking for; in fact, they are only a secondary consideration.

I have a map here, made in 1875 by the riparian commission of New Jersey, and it shows splendid water along this section; certainly nothing there like it to-day. I submit this drawing for the board's consideration.

The condition up to us is due, we may say, in part to the dike. We know that the Fishers Point Dike, placed in 1885, was placed there simply because Philadelphia needed a deeper channel. We have no quarrel with that dike. Just as Col. Kuhn said, the dike was placed there to take care of the Philadelphia interests, which at that time were everything, and Camden's interests were absolutely nil; we confess that, and, besides, Camden was asleep. This is not the case to-day, because we are growing. We have lots of industries that are making inquiries day by day for sites along the water front, and when we submit propositions of this kind for them out our way we are turned down immediately because we have not got the water, which is very true, and there is no help for it. They say there is no immediate prospect of deepening that channel, and consequently any proposition that comes up which would make traffic has to go by the board.

We have no quarrel with the Fishers Point Dike, but we have a quarrel with that later dike which extends from Fishers Point to Petty Island. I don't think there is another man who has watched the proposition as closely as I have. I want to say this, without seeming braggadocio or egotism, that I have watched this proposition very closely, and I know that the low-water dike is more harmful than it is good for it. I am sure that I am able to prove that. In the first place, we all know how the Fishers Point Dike is intersected at almost an acute angle to the flow of the river. Now at a half-run tide—and this I am saying without fear of contradiction—if one observes the flow of water as it hits the dike, you will see an eddying condition; you will see and notice that the water is looping down underneath, and by sounding just 25 or 30 yards just outside of this apparently quiet water you will find that the pull on your sounding line is outward. If you take this map [presenting map] and look over to this point you will see that it is as though a giant hand had shaved the ground out there. It has deepened Philadelphia's channel, which was perfectly right and proper. The engineers have decided correctly, as far as deepening of the channel was concerned. Diking, while it is the cheapest dredging, is at the same time the dearest dredging, because, while it deepens one part, it deposits the mud somewhere else; it never removes it. The water strikes this low-water dike, rolls down along Petty Island, and it is a matter of common knowldge out there to know that Petty Island is part eaten away by just this current. It flows down along Petty Island and tears away the shore. The erosions then necessarily must go somewhere. Part of them have found their way over to Philadelphia and were taken out by your department. Another part has gone to lengthen the bar which is at the end of Petty Island, and has extended that bar down river. That bar has been growing ever since the placing of the dike. The majority of the erosions, however, sweeps over into our Jersey channel and is taken up by the flood tide and deposited in the approaches. Naturally, it is very true what your honorable board said, the approaches are shallow, but it is due to that dike. Consequently we have to this day only a narrow apex of that curve which is travelable and permits a decent traffic.

Col. Henry C. Newcomer. Have you seen the map of the late survey?

Mr. von Nieda. I have a map which was given me by the State board of commerce and navigation. I have a small replica here.

Col. Newcomer. This map of the survey made by the district officer shows a width of over 300 feet, with a 12-foot depth at low tide. I suppose they must have at least 200 feet wide with a depth of 15 feet at low water.

Mr. von Nieda. We have difficulty in bringing a tug up there with 10 or 12 feet draft.

Col. Newcomer. Apparently because they are not in the channel. The map shows a channel of that depth.

Mr. von Nieda. We have tried to make that just as careful as we can.

Col. Newcomer. Where would a tug drawing 10 or 12 feet try to go at low tide? What is its destination? Of course, it could not get to these wharves, because there are no channels leading to the wharves.

Mr. von Nieda. No; there are not.

Col. Newcomer. So far as a channel out in the stream is concerned, the depth is there. In many places it is 20 feet or more.

Mr. von Nieda. There are a few holes in there, but there is no depth of that kind that I know of.

Col. Newcomer. The map shows it. There is 300 feet between the 12-foot contours. I don't know what it is between the 15-foot contours—possibly not much—but the 12-foot contours have deeper water between them. It runs down anywhere from 15 to 20 feet.

Mr. von Nieda. This condition of a fairly good channel holds good for about halfway down the island.

Col. Newcomer. This channel I am speaking of extends the whole way through.

Mr. von Nieda. The lower part is the deepest part. Of course, we are not pleading for just merely this thing because we want something, but because we really need it. We have to have it in order to let our traffic come up.

Col. Newcomer. Well, your tug drawing 10 or 11 feet certainly could get up there if it stays in the channel.

Mr. von Nieda. I would like to state this: If 15 feet was the universal depth there, it would be possible for the Noecker & Ake shipyard to bring their vessels there when they unloaded. Years ago they brought schooners to that point and unloaded them.

Col. Newcomer. Where?

Mr. von Nieda. At their wharf.

Col. Newcomer. There is no wharf along here of that depth; the waterworks wharf has about 10 or 11 feet.

Mr. von Nieda. At this time the waterworks probably has the best water.

Col. Newcomer. Yes; but they are all shallow.

Mr. von Nieda. At this time the Noecker & Ake Co. are compelled, when its lumber is brought here from the South, to have it unloaded at either Race or South Street, Philadelphia, have it transferred to steam cars, ship it up to Frankford, over to Pavonia, and team it from there to their yard, which makes about $3 additional on every thousand feet of lumber that they ship.

Lieut. Col. W. V. Judson. How much did those schooners draw?

Mr. von Nieda. Seventeen and 18 feet.

Col. Newcomer. This map apparently shows that they have about 10 feet out near the end of their wharf. They have to go out quite a distance for 12 feet.

Mr. von Nieda. There no doubt are good depths in some parts of that channel, but what we would like to have is a universal channel so that we can bring our vessels up without danger.

Col. Judson. How deep a channel do you need there?

Mr. von Nieda. We ought to have at least 12 feet at low tide, and we would certainly appreciate a 15-foot channel a good deal better. The main thing we want is the opening in that dike. We want that additional opening. With Fisher Point Dike in, gentlemen, and the low-water dike out, we would not now be asking Federal aid. We are confident of that.

Col. Newcomer. While you are on that question of channel—you think you need at least 12 feet and probably 15 feet—would the location of that channel as proposed by Col. Zinn, practically on the line of deepest water, be satisfactory?

Mr. von Nieda. Very satisfactory. We would certainly come out to it.

Col. Newcomer. You have 12 feet there, and 300 feet wide, now. There is nothing shown here without at least that much.

Mr. von Nieda. That can not be true everywhere, because the tugs will fetch up.

Col. Newcomer. The channel is not marked, and they may not be aware of the location of the best water.

Maj. J. C. Oakes. The channel is not buoyed. They may not know where the deep water is.

Col. JUDSON. Why should a tug start up there now, if he could not get to any dock?

Mr. VON NIEDA. They don't attempt it any more. It has been abandoned.

Col. JUDSON. Is not that the real reason? They could not get to a wharf drawing 12 feet.

Mr. VON NIEDA. Of course at low tide they would not attempt it. We have some traffic left yet, and we have quite a good deal of shipbuilding. The barges are being pushed over there. I was told not long ago by the Tucker people, and this was confirmed by Mr. Noecker, that they would have to jam their barges over at low tide.

Col. NEWCOMER. The point is that you don't have now nearly as much water at your wharves as you have out there in the stream.

Mr. VON NIEDA. That is true.

Col. NEWCOMER. Then what is the use of providing more water? What you want is deeper water in your wharves. Is there any promise on the part of wharf owners to dredge their approaches?

Mr. VON NIEDA. They will come out to that channel if it is placed there.

Col. NEWCOMER. Why don't they come out to this present channel?

Mr. VON NIEDA. I am not the man to say that, but I am confident that the men who handle the boats must know something about it. They say it is no longer safe. I know that some of the work at the Noecker & Ake shipyard had to be turned away.

Col. JUDSON. They could not get anywhere near these docks anyway, because they only have 10 feet at the extreme outer end of them. No matter if there were 20 feet in the channel, they would have to turn it away just the same.

Mr. VON NIEDA. Mr. Ake and Mr. Noecker are here today, and they will perhaps explain how they handle vessels of larger draft than 12 or 15 feet. If it is agreeable to you I want to submit this brief, gentlemen; I want to plead with you to give earnest and good consideration to our plea. Above all things we do want, if it is at all possible, we do want that low-water dike eliminated, because that has been our bugaboo, and has caused the shoaling at our wharves. It is due to that dike. I want to submit this brief, sir. [Submits brief.]

Col. NEWCOMER. Your idea is that the elimination of that low-water dike would give greater flow there and keep it cleared out better.

Mr. VON NIEDA. And I believe it would not be prejudicial to the Philadelphia Channel.

Col. JUDSON. Is it most because you want to get the water in there, or because you want the entrance enlarged for vessels to pass through?

Mr. VON NIEDA. We want an entrance for vessels, of course. We can rejuvenate that thing once more. We can come back to the traffic that we once had if the dike is taken out. We have had a hydrographic engineer examining our claim, and we have been supported by him in this statement. We are not giving you to-day merely figures produced by a laymen like myself. I confess that I am only speaking for others, and as the mouthpiece of this hydrographic engineer. He has made us these little prints, and in support of my argument I would like also to submit them. [Presents prints.] We have with us to-day the secretary and chief engineer of the State Board of Commerce and Navigation of New Jersey, and would like very much to hear from him.

Mr. B. F. CRESSON, Jr. Mr. Chairman, I am appearing in behalf of the New Jersey State board of commerce and navigation. I think it is rather a question as to whether I should not apologize to you for appearing before you so many times. During the last week I have been before you as senior member of the New York Harbor Line Board twice and again to-day. If you will remember, last Friday I appeared before the New York Harbor Line Board in opposition to the application of certain interests in New York Harbor to create a large artificial island. The basis of that opposition was that it might prejudice the projects which the city of Newark, the city of Bayonne, and the city of Jersey City were attempting—the great developments that were going on there and were projected. Yesterday I had the honor of appearing before you in regard to the extension of certain lines in Newark Bay, feeling that if these lines were extended, they might prejudice the development of the lower bay and endanger from floods the properties along the Passaic and Hackensack Rivers. To-day I am appearing on behalf of the State board of commerce and navigation to request that the Government do certain things that will make it possible, in the judgment of the board, to increase the commercial advantages of the State of New Jersey. I don't know whether I should apologize or not, because I think that these three appearances at least will serve to show the

State and people of New Jersey and the Federal Government that there is a board in the State of New Jersey that is looking after the interests of the State, and I am sure, from your knowledge of the stand that this board has taken, that you will believe that we have the interests of the Federal Government at heart as well. I am bold enough to say, Mr. Chairman, and I do not mean any reflection at all upon the former Government engineers or upon the citizens of Camden, that if there had been a State board with the powers of the present State board, with their interest in public affairs, the affairs of the State—I venture to say that if such a board had existed in 1885, that the Fishers Point Dike would not have been built. I have been looking up some of the old records, and I would like to read to you some extracts from the annual report of the riparian commissioners of the State of New Jersey for the year 1885. In Appendix C there is a report by Mr. R. C. Bacot, the engineer of the riparian commissioners, to the board of commissioners on this very question. He states with regard to the Fishers Point Dike—this was dated October 31, 1885—that: [Mr. Cresson here quoted at some length from the report]. This report, which I will leave with you, contains also an Appendix D—some reports of Army engineers. There is a letter from William C. Endicott, Secretary of War, addressed to the Hon. W. J. Sewell, United States Senator, in Camden, dated November 9, 1885, which says:

"In regard to this matter the views of the board are concurred in by the Chief of Engineers and have been approved by me in accordance with his recommendation."

There is also a letter from the Chief of Engineers, Gen. John Newton, in which he says:

"It will be seen that the board has given patient consideration to the objections urged by the citizens of Camden, many of whom presented their views in person, and report that they can not bring themselves to view these objections in the serious light in which they seem to be regarded by the gentlemen who presented them, and it appears to be more than probable that much of the importance which has been attached to them has arisen from the belief that the contemplated dike was to be, as erroneously stated in the information laid before the chancellor of New Jersey upon which an injunction was obtained, a solid high-water dike extending from Fishers Point to the head of Petty Island, completely closing the channel. On the contrary, the proposed dike is to be a low-water dike, over which the tide will ebb and flow partially, and it is to extend only about halfway across the opening between Fishers Point and Petty Island.

"The board further remarks that it does not appear that there are any other means available of successfully maintaining the requisite channel depth in this part of the Delaware River and recommends that the construction of the dike be continued and completed."

Gen. Newton concurs in the views of this board. The board was composed of William P. Craighill, lieutenant colonel of Engineers; Walter MacFarland, lieutenant colonel of Engineers; G. L. Gillespie, major of Engineers; and W. H. Heuer, major of Engineers. Their report is very interesting. It says, in part:

"It is probable that in the cove formed between this dike and the mainland a deposit will take place which may finally result in filling it up, and in this way the brickyard and other property may be affected, but whether favorably or unfavorably time only will determine. It is not believed, however, that the work proposed will reduce the volume of water which now passes through the New Jersey Channel to such an extent as to affect injuriously any of the other interests referred to.

"Should the time ever arrive when through changes in the regimen of the river it would become necessary to close this channel completely in order to preserve the main channel, some of the evils now feared might follow, but this is a distant contingency, and in the event of its occurring Congress would doubtless willing to afford relief for local damage, which the general interests of commerce and navigation may have made it necessary to inflict."

This report also shows a map, which is dated 1885, and which shows the Fishers Point Dike just about halfway between the mainland and the end of Petty or Treaty Island, not as it is at the present time. You will observe that the statement of the engineers at that time was that the dike was to be only half the distance between them.

The board of commerce and navigation has a number of interests in this matter. In the first place anything that tends to increase the availability of water front tends to encourage commerce to come. The board of commerce and navigation in carrying out its duties is, of course, most anxious to do everything that is possible to bring commerce, for with commerce, of course, comes the industries and population. The board has a further interest in that the making of these lands more accessible would increase the value and the demand for riparian rights, and the State would be requested to convey and would be able to get better prices for riparian lands. Of course, that is a minor consideration, but it is quite important, as you will understand that the riparian lands of the State and all of the receipts from the riparian lands are devoted to the support of free public schools.

I have also, gentlemen, a personal interest in this matter. Some few months ago the board of harbor commissioners of Camden requested the State board of commerce and navigation to work with them on a plan of harbor development. They passed resolutions to that effect, and they set aside a certain sum of money, and the board of commerce and navigation turned that matter over to me. For the last two or three months I have been working with the people of Camden. We sent out, one of the first things we did—and I say this to show the interest that the people of Camden take in the development of their water front—about 160 requests on the merchants of Camden for information concerning their industries, inquiring their needs concerning the water front, and asking for suggestions. Out of those 160 within the week we had nearly 70 replies, which, in my experience in these matters, is quite unusual, and indicates the eagerness of the people of Camden to do something. I have been working with the board of harbor commissioners and hope to have a full report, with recommendations, to submit to the people of Camden, through the commissioners, by the middle of October. So far I have not put any plans down on paper, and I have spoken to no one about it particularly, but I think it might be possible and proper at this time to anticipate that report in just one respect. One of the recommendations which I have decided to make is that the waterworks dock, which belongs to the city of Camden, located at Twenty-fifth Street, directly behind Petty Island, shall be improved. This is an old dock, but without a very large expenditure of money it will be possible to improve this dock, extend it, and make it available for the receipt of coarse freights, such as coal, lumber, sand, rubble stone, gravel, and in addition to providing the wharfage for it, provide certain facilities for storing it. This wharf is then to be provided with a channel leading to the channel behind Petty Island. That was one of the provisions that was contained in Col. Zinn's report. Whether the city of Camden will see fit to carry them out or not is something that I don't know, but they will have that recommendation from the State board.

Col. Newcomer. May I ask what depth of channel you contemplate at that dock?

Mr. Cresson. We contemplate sufficient depth to provide for the landing of scows containing coarse freights, of boats containing lumber, and of tugboats.

Col. Newcomer. I mean have you determined yet in your mind what number of feet?

Mr. Cresson. We have not finally determined, but sufficient depth to take care of that commerce.

Col. Abbot. There are barges which draw all the way from 13 or 14 feet up to 22 and 23 feet and even higher. Would you have any idea of taking such barges up to that wharf, and having at the head of the wharf a basin so you could take a barge in at high tide, and let it remain there without grounding at low tide, or simply make a depth at the wharf which would correspond with the depth in whatever channel there may be leading from the Delaware River channel to the vicinity of the wharf?

Mr. Cresson. As we work out the details we will provide for the general class of barge that is handling those commodities at the port of Philadelphia. That is as definite as I can answer that question at this time. Certainly we will not provide for seagoing ships or anything like that. It is more for the local trade, for the building up of that vicinity, for open wharfage such as we have in Newark, and as is so much in demand. I apologize for taking up so much of your time, but wish to say in conclusion that I am directed by the State board of commerce and navigation to request favorable consideration of this project by your board. Thank you.

Col. Judson. May I ask, in the event of favorable action would these riparian lands be built out to the pierhead line, or to this channel that Col. Zinn has?

Mr. Cresson. I intended to present a map. This map was prepared in May, 1915, by the board of commerce and navigation. It shows the situation very clearly. It shows the exterior riparian lines that have been adopted by the State. It shows the channel which is contemplated in Col. Zinn's report. We have marked in here all the grants and leases. The State is the owner of all lands out to low water until it is conveyed.

Col. **Judson**. Does the riparian owner have the first right to acquire it?

Mr. **Cresson**. He has the first right.

Col. **Judson**. You fix the price first?

Mr. **Cresson**. Yes. A nonupland owner may apply for lands under water. The upland owner is then given six months in which to purchase it, and if he does not then act it is sold to the nonupland owner.

Col. **Newcomer**. In that case would the land extend out to low water?

Mr. **Cresson**. It comes directly from the high-water line out to the exterior line that is adopted.

Col. **Judson**. The riparian owner gets no compensation for the loss of his rights?

Mr. **Cresson**. Not if he does not take it up. The program is that a man makes an application for riparian rights. The State indicates a line and fixes a price. The man can either take it up at the sum fixed or lease it and pay 7 per cent on the fixed value.

Col. **Abbot**. Do you give a grant out part way, or do you ever give a grant running from the exterior line part way in?

Mr. **Cresson**. No; in a case like this, where the exterior line is shorter than the shore line, we have to flare them to a certain extent. The State fixes the lines.

Col. **Judson**. What would the riparian rights be worth in a general way?

Mr. **Cresson**. I can not answer that. I will be very glad to furnish you such information as I can get.

Col. **Judson**. Could your commission sell them to the Government under any law of the State of New Jersey?

Mr. **Cresson**. Yes; provided the upland owner was given six months in which to take it up and did not take it up. I presume that the Government, under condemnation proceedings, would be able to acquire it by paying for it.

Col. **Newcomer**. Where is the dividing line between the States?

Maj. **Oakes**. The center line of the Delaware River.

Mr. **Cresson**. I will be glad to leave this map with you, Colonel. [Presents map.] I would like to say that there was a conveyance made within a few months to a very large concern, and there is a very big industry going up this end of Petty Island.

Col. **Judson**. The State does not recognize that this owner has any particular right, except as the State grants that right by legislation. He has first claim to this land out here, but it absolutely belongs to the State. Do you think that the State would be willing to cooperate in this improvement with the United States, if the United States were to expend so much money here? Would the State deed this to the Government so that the Government might have a place to deposit spoil from dredging? Would the State make that contribution if the work was going on?

Mr. **Cresson**. Under a recent opinion that we had from the attorney general of the State there was a property owner who had taken out a grant on a part of his water front and asked the permission of the board to refrain from building a bulkhead to maintain his fill, but to allow that fill to run over on the property of the State of which he was the upland owner, and he agreed to file with the State any sort of a bond or agreement that in doing that the interests of the State in this land would not be prejudiced in any way. We referred it to the attorney general, and his opinion was that the board had no right to permit any structures of any kind to be built on these lands unless they had been conveyed.

Col. **Judson**. If you conveyed them to the United States they could be filled up.

Mr. **Cresson**. Yes; but that conveyance would have to be on some fair consideration.

Col. **Newcomer**. The State itself could cede it by legislation.

Mr. **Cresson**. These lands outshore are a trust for the support of free public schools. They are a State trust, under the constitution of the State. It is unconstitutional for the State to give them away. They can be sold, of course. The form of agreement that may be made is quite elastic. The former riparian commission and the present board of commerce and navigation are fairly free in the kind of conveyance that they want to make, but they can not make a conveyance at a nominal consideration.

Mr. E. G. C. **Bleakley**, city counsel. Your point was that you wanted a place for the United States to dump material?

Col. **Judson**. Yes.

Mr. **Bleakley**. An arrangement like that could undoubtedly be made.

Col. **Judson**. But the Government would not get any benefit from it.

Mr. **Cresson**. I feel perfectly sure that the State board would cooperate in every possible way.

Mr. **von Nieda**. Mr. Chairman and gentlemen, it affords me pleasure to introduce Mr. E. G. C. Bleakley, city counsel of the city of Camden.

Mr. **Bleakley**. Mr. Chairman and gentlemen, I have been reading over the letter that was sent under date of June 28 by your board to the public and to our people in this vicinity. I just want to address myself to the crux of that communication, which I conceive to be this:

"From the information presented the board is not convinced of the advisability of the United States undertaking any improvement at this locality at the present time for the reason that the existing depths in the main channel behind Petty Island appear to be fairly adequate for the traffic making use of this channel."

In the second place you say:

"The difficulties that exist are mainly due to shoal water at the wharves and in the approaches thereto, but these conditions are customarily left to the care of local interests."

I think I must agree with your honorable board that the existing depths are fairly adequate for the traffic making use of the channel, but it seems to us that the question goes a little deeper than that, namely, not the traffic making use, but the traffic that might, will, and should make use of this particular channel, which, of course, brings us to the question of traffic that did make use of that particular channel. We have heard the statements of these gentlemen of what happened there in the past, of the traffic that used to come there, and we have here in this room owners of property in that vicinity, residents who can testify and give evidence, if you so desire, of the vessels that used to go up and down that channel. As one of them told me, there was a 35-foot channel there. That brings me to the second point: The difficulties that exist are mainly due to shoal water in the wharves and approaches. In other words, Is that shoal water a natural condition or an artificial condition? We must all admit that it is artificial, brought about by this dike. We are not here to criticize the Board of Engineers or the department who permitted and authorized that dike. Whoever did it had good reasons for making that concession to the Philadelphia business interests, but when they did that they did an injury to the business interests of the city of Camden, for which the business interests of the city of Camden are in no way responsible. They are not even responsible for the placing of the dike there in the beginning, for, if I have Mr. Cresson right, the city of Camden bitterly contested that decision and arguments were presented in behalf of the city of Camden that the condition that now exists would come about. If I heard that report rightly there was almost a promise in the Chief of Engineers' report to the department that Congress would take care of this situation if it ever occurred. In other words, if this shoaling took place by reason of this dike that the Federal Government would take care of that situation for the protection of the local interests. Now that is the situation that is here to-day. You say that customarily these matters are left to local interests. Customarily is true, but this is a case that is extraordinary.

Col. **Abbot**. You are referring to the shoal water at the wharves?

Mr. **Bleakley**. Yes; because this channel used to come away in. Not in the place where it is now located, but just a few feet out from the fast land. I am told by residents that——

Col. **Newcomer**. That is apparently a mistake, according to the records of the Coast and Geodetic Survey. We have on this map, in red, the contours taken from the survey of 1879, which was before that dike was built. It shows that the 12-foot contour at that time just about ran through the end of the Rickenbach Wharves. Now the 12-foot contour is probably about 80 or 90 feet from them. The shoaling has probably been about 2 or 3 feet.

Mr. **Bleakley**. One of the owners has told me that there was a 35-foot channel there. I know nothing about it myself.

Col. **Newcomer**. There was no 35-foot channel back of this island.

Maj. **Oakes**. There was not even a 35-foot hole, was there?

Col. **Newcomer**. There is one sounding of 32 feet.

Mr. **Bleakley.** There was a much better channel.

Col. **Newcomer.** Only a matter of a couple of feet.

Mr. **Bleakley.** Is it not a fact that there has been a great deal of shoaling in back of that channel?

Col. **Newcomer.** Shoaling, yes; but only, apparently, a couple of feet.

Mr. **Bleakley.** I think you can fairly regard this as due to the artificial conditions created.

Col. **Newcomer.** The wharf owners do not now provide a depth equal to what is out in the stream.

Mr. **Bleakley.** There is no inducement.

Col. **Newcomer.** Why not?

Mr. **Bleakley.** If you say there is just 2 feet of shoaling due to this dike, that has been going on for some time.

Maj. **Oakes.** Two feet in 30 years.

Mr. **Bleakley.** But they have done a lot of dredging and spent a lot of money.

Col. **Newcomer.** There is no evidence that they have spent any money in dredging channels to the wharves. They may have dredged along their wharves.

Mr. **Bleakley.** They have possibly not dredged to the extent of 15 feet deep 1,000 feet wide, but they have done some dredging.

Col. **Newcomer.** They claim there is inadequate depths at their wharves. There is much greater depth in the stream. Why don't they provide the same depth at their wharves as that in the stream?

Mr. **Bleakley.** In the first place, it is too far out.

Col. **Abbot.** That would not be changed by carrying out Col. Zinn's project at all.

Mr. **Bleakley.** Well, any deepening of the channel would help the shoaling to some extent, because the sediment must be deposited, and the deepening of that channel would cause some of it, at least, to drift in there. I can not see how there can be any question but what that dike has caused some shoaling; it changed natural conditions.

Col. **Newcomer.** It probably has.

Mr. **Bleakley.** To that extent these people are entitled to Federal aid, aside from the custom of this board.

Col. **Newcomer.** We have never done any dredging along wharves where there was shoaling created by Government works.

Mr. **Bleakley.** Well, that is the situation here.

Maj. **Oakes.** Considerable shoaling has taken place in the wharves in Philadelphia Harbor. It has to be removed by the private individuals.

Col. **Abbot.** There have been Supreme Court decisions on the question where there were two alternate channels and one had to be closed, that the United States was not responsible for the damages to the channel which was closed. It has been definitely decided by our Supreme Court.

Mr. **Bleakley.** I don't question the right of the Government, but the equity of the situation, the right between man and man, which the Government will always consider. We are not here to demand this thing; we are here to ask it. We are in no sense demanding it.

Col. **Newcomer.** Then you want something different from Col. Zinn's project?

Mr. **Bleakley.** No; his project suits us very well.

Col. **Newcomer.** But he did not propose to dredge along the wharves.

Mr. **Bleakley.** No; but there would be some encouragement for the owners to dig and dredge.

Col. **Newcomer.** The channel he proposes is 15 feet deep and 1,000 feet wide. You can probably get up there with a 15-foot boat now.

Mr. **Bleakley.** Yes. As I understood your objection here, it was because the Government was going to spend some money for local interests which customarily you did not do.

Col. **Newcomer.** That is not the point.

Col. **Judson.** I think the point was that if the money was spent the channel would not be utilized by anybody.

Mr. **Bleakley.** That is, not by the local interests. Well, these owners are here to answer that.

Col. **Newcomer.** They don't utilize their present channel.

Col. **Judson.** A 12-foot channel is all that exists up to Trenton. That is a little more than those barges draw that go up and down the bay and to southern points. Twelve feet seems to be a sort of useful depth. Considerable navigation is carried on with 12-foot draft boats, but there is nothing that requires

15 feet. If you must have more than 12 feet, then there is nothing adapted to that greater depth until you get up around 25 or 30 feet.

Mr. **Bleakley**. Well, this is a matter that concerns the whole water front of the city of Camden. Eighteen feet is not enough for us.

Col. **Judson**. What class of barge would require 15 feet that could not get along with a 12-foot channel?

Mr. **Bleakley**. I don't know what an ordinary schooner draws. I was speaking the other day to one of the large manufacturers here in the city. He was talking about purchasing a piece of property, and the depth of water was an important matter. He could only find 18 feet, and that was not enough.

Col. **Judson**. That is just the point. There is not very much difference in value between 12 feet and 18 feet. There is a certain class of boat——

Mr. **Bleakley**. Twenty feet here would have been all right.

Col. **Judson**. What fellow would ever want 15 feet for that class of boat?

Mr. **Bleakley**. I don't know. Your chairman said some coal barges are 22 feet.

Col. **Judson**. Yes; but there are none at 15. They seem to jump from 12 up to 20 feet or more. They are built to accommodate the traffic in southern waterways.

Mr. **Bleakley**. There must be a number of boats in between.

Col. **Judson**. They don't frequent this port. The little harbors along Delaware Bay are deepened to 12 feet. The southern routes are all 12 feet or less.

Mr. **Bleakley**. I think there are a number of vessels that run in between 12 and 18 feet.

Col. **Judson**. In some parts of the world; maybe. Here it seems to me they are very limited.

Mr. **Bleakley**. It may be so. There is one concern up there now that has spent thousands of dollars on a plant, and they have about concluded to move it simply on account of lack of water facilities.

Col. **Judson**. At their wharves?

Mr. **Bleakley**. No; to get in there. They are willing to do some dredging if there is any inducement. That is the point.

I think the point is clear in this statement that the board made on June 28, that this condition is customarily left to the care of local interests. The point I want to make is this: This is a case that should not be left to local interests, because it is out of the ordinary. Therefore we have a peculiar claim on Government aid and Government help, because the situation created there by the Government is unnatural. We are not criticizing the Government's action. We would not want to deprive Philadelphia, but at the same time we were wronged at that time. We have been a long time in presenting our claim, but we are presenting it now. That is the point I make, to take this question outside of ordinary custom.

Col. **Abbot**. Do I understand that you would want the United States to dredge the 2 or 3 extra feet in front of these wharves—the shoaling which you think has been caused by the dike?

Mr. **Bleakley**. Not there, but give us the benefit in that vicinity. Col. Zinn's report gave us those 2 or 3 feet. I am not asking you to dredge for private interests; but, because these private interests have been harmed in the past and have been deprived of their natural channel and therefore suffered harm, that is a reason, and a good reason, why they should have Federal help, because the Federal Government in 1885 deprived them of certain benefits. It is not damages, but equity.

Col. **Abbot**. Quid pro quo, so to speak.

Mr. **Bleakley**. Certainly. That is the particular point that I would like this board to consider. If necessary, I will submit a short memorandum covering that point. I just want to say that, of course, ordinarily those private owners could not dredge or dig out or build a wharf to the line of that channel without the State board of commerce and navigation not only giving them permission, but changing the riparian line, changing the solid line, and changing the wharf line.

Col. **Newcomer**. They could get a permit to dig a channel?

Mr. **Bleakley**. That question is now before the board. I think there is a suit pending now against any local owner even dredging. Is that not so, Mr. Sherman?

Mr. **Sherman**. Yes, sir.

Mr. Bleakley. It was brought by the State. I am only just stating the fact.

Col. Newcomer. The Federal Government will give them a permit to dig.

Mr. Bleakley. They could not dredge in the past, because the line has been fixed. We think we can get the line extended by the State to a certain extent, but we still feel that we ought to have this help from the Federal Government.

Mr. von Nieda. May it please you, Mr. Chairman and the board, I would like to introduce Mr. John Dempsey, one of the men who has had a plant along that channel, who will tell you the experience they have had, and their conditions to-day.

Mr. John Dempsey. Mr. Chairman, as I understand this issue, it is for the removal of part of the Fishers Point Dike. Now, gentlemen, our business is barges and tugboats. We also have some land, approximately 300 feet on the Camden side of the river between Petty Island and the shore, and my experience is this, gentlemen: I think we took possession of that land around 1900. There was a temporary wharf built up there before we came there. At the end of that wharf we had at least 5 feet of water, and to-day we have not any water for 100 feet outside of that wharf. Now, as to my land, it is this: I was before Col. Zinn at that time. I can show it to you on that map. The dike runs too far from Fishers Point by at least, I judge, 900 feet. We have an opening of 300 feet. Three hundred feet is not enough to get in there with a tugboat and tow. We have had a tugboat and barge ashore there on the end of the island, coming through there with ebb tide. You have to cut across the tide to get through, and if you don't get through quick enough, you will bring up on the island. We got that barge and tug away from there, fortunately, but only by the quickest kind of work, before we could be gotten in for thousands of dollars damage. If I had occasion to go through there to-morrow with a tow, I would say, "Go around the island; don't try it again."

Col. Newcomer. How much delay does that involve?

Mr. Dempsey. How much delay? Well, at night about 15 hours. In daytime——

Col. Newcomer. No; what I mean is how much longer does it take to go around the island?

Mr. Dempsey. Oh, a couple of hours.

Maj. Oakes. We ran around it in half an hour to-day, on our tug.

Mr. Dempsey. Did you undertake to go through between Fishers Point Dike and the end of Petty Island?

Maj. Oakes. No; we went down around.

Mr. Dempsey. Why didn't you come through?

Maj. Oakes. We didn't want to.

Mr. Dempsey. Yes; that is the trouble there; you can't get through. I suggested to Col. Zinn that you open up that place to 1,200 feet. Take at least 900 feet from the outer end of the dike—take it out—leave an opening of 1,200 feet. We would be satisfied.

Maj. Oakes. What do you want the opening there for?

Mr. Dempsey. To get through. I can show you on the map.

Maj. Oakes. To save about 30 minutes?

Mr. Dempsey. This dike has caused silt to come in and fill up in front of our properties along there.

Col. Judson. The saving would only be on such traffic as is coming from opposite Petty Island and above. If it was coming from below the island it would be just as well, if not better, to come around the island. The delay is on a very small part of your traffic.

Mr. Dempsey. We go up and down the river with our business. We find we can't get through there at all.

Maj. Oakes. It is not expected that you should come through there. The channel now is around the end of the island; the upper end is practically closed except for motor boats. It is not expected to go through there with 12-foot draft.

Mr. Dempsey. You might try it in daylight. I should think that we are entitled to some right to come through there and come to our own place.

Maj. Oakes. You are not entitled to come through a place where there is not sufficient depth.

Mr. Dempsey. The Government took it away from us. We are only asking for an opening 1,200 feet wide through that dike. It would clear the Government of a lot of expense for dredging. It would dredge itself and give us a channel.

Col. Newcomer. What is your business?

Mr. **Dempsey.** Transportation and towing.

Col. **Newcomer.** What do you tow through there?

Mr. **Dempsey.** Barges.

Col. **Newcomer.** Loaded with what?

Mr. **Dempsey.** Loaded with iron pipe, sand, different commodities. We took up a lot of railroad ties a short time ago.

Col. **Judson.** What do these barges draw, loaded?

Mr. **Dempsey.** Nine feet.

Col. **Judson.** Would you load them deeper if you had water?

Mr. **Dempsey.** Yes.

Col. **Judson.** How deep?

Mr. **Dempsey.** Twelve feet. Gentlemen, I came up to Noecker & Ake's yard about two years ago with a barge with a hole in her. I wanted to get that barge to Noecker & Ake's wharf, which is a permanent wharf, and I couldn't get her within 25 feet of that wharf. I finally found the hole and stopped it up, but it cost us a lot of money.

Col. **Judson.** What did she draw?

Mr. **Dempsey.** Twelve feet.

Col. **Judson.** You had plenty of water in the channel, but not near the wharf.

Mr. **Dempsey.** This wharf is near the channel.

Col. **Newcomer.** Why don't they dredge out to it?

Mr. **Dempsey.** They did dredge out.

Maj. **Oakes.** They are 300 feet from the channel.

Mr. **Dempsey.** There is no use dredging out. We have a property up there now that I am selling for the machinery. We spent $75,000 there; $15,000 for the plant. I am dismantling it to-day because we can't get to it.

Maj. **Oakes.** What depth did you need?

Mr. **Dempsey.** All I am asking is to take the dike away, and I will put the depth there.

Maj. **Oakes.** What depth do you need?

Mr. **Dempsey.** About 10 feet.

Maj. **Oakes.** You have that.

Col. **Judson.** I see what you are trying to say. If we take out that dike up there, leaving an opening 1,200 feet wide, it will maintain the depth that you had at your wharves.

Mr. **Dempsey.** We will be satisfied to go on with the work. Take that dike away from there, let us have some assurance that it won't fill in in a year or so.

Maj. **Oakes.** Where is your property?

Mr. **Dempsey.** Opposite Twenty-ninth Street.

Maj. **Oakes.** Opposite Twenty-ninth Street the 6-foot contour has moved forward since 1879; the 12-foot contour is in practically the same place. You have 15 feet of water in the channel opposite your property.

Mr. **Dempsey.** Yes; but that is on the other side from our property.

Maj. **Oakes.** The 6-foot contour has moved forward, but the 12-foot contour is in the same place.

Mr. **Dempsey.** I have been there, and I know what I am talking about. You can not get within 50 feet of our dock, and we used to have water there. It has done that since we went there.

Maj. **Oakes.** The low-water line has shifted; yes.

Mr. **Dempsey.** Here is what I want to explain. [Points out several features on map.] There is not opening enough in this dike. All we ask is to take away 900 feet of this present dike, and leave a 1,200-foot opening through it. We will be satisfied; we will take care of the rest of it.

Col. **Abbot.** Then you don't ask for dredging in the channel below? You think the increased current would attend to the maintaining of it?

Mr. **Dempsey.** Yes, sir.

Maj. **Oakes.** Mr. Chairman, several statements have been made here that I think are misleading. Apparently the map that we have here, that was submitted by Col. Zinn, shows a recent survey, and also, marked in red, it shows soundings taken from the Coast and Geodetic chart of 1879, I believe. The chart does not show a serious depreciation of the channel or any conditions of serious shoaling, considering the 30 years that have elapsed. On the Philadelphia side, my assistant engineer, Mr. Shuman, informs me that dredging is done constantly, and that if they had allowed their slips to be undredged for 30 years they would have more than 2 feet of silt in them by this time. They dig out from them about 2 feet a year. If this Fishers Point Dike were eliminated, and they did no dredging in their slips and along their wharves, there would still be shoaling, the same as has taken place, possibly more. The point I particularly wish to mention to the board is this: That the Fishers Point Dike is necessary for the maintenance of deep water in the Delaware River opposite Philadelphia that has been adopted as a project. The dike has been efficient in its action, and it would be a mistake for the board to recommend the elimination of any part of it. The opening left there was not left there with the intention that ships or tugs with tows should attempt to go through there when they draw as much as 10 or 12 feet. It was left for motor boats, small sailboats, and boats of that character. The gentleman who has just spoken tells of the difficulty of getting through there, and that he ran the risk of losing his barge. It was a dangerous operation, and one that I would not have attempted. There was ample water for him to get to his yards, without running any danger, by going to the lower end of the island and coming up the channel behind the island. He ran the risk that he did rather than go around the island, which would take him perhaps an hour longer.

Now, in order that I may place myself in a proper position with the people of Camden, I desire to state that I believe that they are ready to dredge their slips and build their wharves out to a channel; that they are entitled to at least 15 feet of water. I wish, however, to have it understood that I am not a member of the Board of Engineers; I am the district officer at Philadelphia, recently arrived. I would like to see them have their 15 feet if they are ready to use it; if they are ready to build their wharves and dredge their slips. Apparently the channel as laid down does not improve the present conditions very much.

Some of the gentlemen have also stated that they had 35 feet some years ago. They may have had a hole in the channel somewhere of some such depth, but this chart shows that in 1879 the greatest depth that could come into this channel then was 15.7 feet. Now that channel has not depreciated at that point; they still have 15, and in fact 16 feet at that point now, showing that the channel has not been seriously injured. It is very improbable that the Fishers Point Dike has injured this channel in any way whatever. If it was closed entirely there would probably be no more shoaling than there is now. The only silt that would be deposited then would be the silt that was held in suspension in the water that came in on flood tide, and that would be a very small amount, not as much as that taking place in the slips in Philadelphia Harbor.

Mr. **Dempsey**. Gentlemen, we are being sacrificed. He admits that there is 300 feet of a channel. I will admit that, too. That is caused by the opening. Let us have 1,200 feet and we will have a 1,200-foot channel.

Maj. Oakes. But we will oppose the opening of that channel.

Mr. **Dempsey**. I know you oppose it, but we are being sacrificed. I can prove that to you. I am selling out—throwing the stuff away—because we can not get to it.

Mr. **von Nieda**. Mr. Chairman, notwithstanding all this, we feel that we still have a right to the elimination of that dike. I believe that the channel on the Philadelphia side would not be endangered to any great extent, in fact I feel it would be benefited, if anything. I think our argument is correct. On the part of the city of Camden we are ready at any time to meet that which Col. Zinn designated as the true cooperation on the part of local interests. He said that Trenton was only given this 12-foot channel when they were able to bring into life a municipal dock. The city of Camden is willing, if the Government sees fit to grant us the proper improvement, to give this proper cooperation which the district officer designated and as I would consider cooperation—we are ready to do that at any time. We have with us to-day one of the largest owners along the water front, one whose plant was designed in the first place to go there—the American Dredging Co.—and afterwards decided on account of insufficient depth to change it to another point. Mr. George Bradley, who is here to speak for the American Dredging Co., is at the same time president of the Camden Harbor Commission, which has passed a resolution that at any time the Government sees fit to improve the channel, the city of Camden will instantly be ready to develop the waterworks wharf at Twenty-fifth Street, and make it into a municipal dock for freight transfer purposes for the public use.

Mr. **George Bradley**. Mr. Chairman and gentlemen, I am president of the harbor commission of Camden, and we have passed a resolution that we would build a public dock, and we still stand good for it. As a representative of the American Dredging Co., I would say that they bought that property with the intention of erecting their plant there. They found that it kept shoaling and they could not maintain the depth that they wanted. That was the reason it was put aside, and we are improving our plant down below.

Col. ABBOT. Did you try dredging it out?

Mr. BRADLEY. No; we found it was getting shallower. Years ago there used to be good water up there.

Maj. OAKES. Where was it to be located?

Mr. BRADLEY. You will find it right there above the waterworks wharf.

Maj. OAKES. How far?

Mr. BRADLEY. Thirty-second Street.

Col. NEWCOMER. Near Mr. Dempsey.

Maj. OAKES. The low-water line has moved out about 100 feet. The 6-foot contour has moved out about 100 feet, and the 12-foot contour is almost in the same place. They formerly had 20 feet opposite that wharf; in the thalweg of the channel 22 feet. They now have 16 or 17 feet.

Mr. BRADLEY. When it came to getting up in there with our plant, which was getting heavier all the time, we found we could not get it up there on account of the shoal spots.

Maj. OAKES. That is very true; you only have about 14 or 15 feet in the thalweg of the channel. How much would your plant draw?

Mr. BRADLEY. Fifteen or sixteen feet.

Maj. OAKES. There never was more than 16 feet, or perhaps 17, across the bar below Petty Island.

Col. ABBOT. It is the growth of your plant that has made this channel insufficient?

Mr. BRADLEY. Well, we naturally thought it would be improved. It was here, only we could not get to it. That is another thing. We found that our plant was getting such that we could not very well get it up there. As far as the city of Camden cooperating with the War Department up there is concerned, we intend to build just as soon as the waterway is provided.

Mr. VON NIEDA. I would like, Mr. Chairman, to present to you a gentleman who had originally intended placing on the property which he represents a plant for the transportation to and fro of building material, and who, of course, has since found that it was an impossibility. I will let him tell his own story. Mr. Smith, president of the North Shore Improvement Association.

Mr. CHARLES ELMER SMITH. Mr. President and gentlemen, in the first place I don't want you to get the idea that anybody wants any part of Fishers Point Dike removed. I guess I know the situation up there as well as anybody, for I live there just opposite the north end of Petty Island. It is the loose stone that is tumbling in there south of the point of the dike that we would like to have removed. We think it is only justice to Camden and to our property that it should be taken away. Immediately opposite the north end of the island there is a mill, known as the Red Mill, that has been abandoned for 25 years. Is was a mill for the manufacturing of hair cloth. There was a wharf there that had 22 feet of water, and to-day it has none.

Col. NEWCOMER. At what street was that?

Mr. SMITH. About Thirty-eighth Street, just beyond the boundary of the city of Camden.

Col. NEWCOMER. You say a wharf with 20 feet of water?

Mr. SMITH. There was; yes, sir. I remember it.

Col. NEWCOMER. What time was that—1879, or along there?

Mr. SMITH. About that time. I was a boy then.

Col. NEWCOMER. This map shows the soundings in 1879.

Mr. SMITH. From Thirty-sixth Street up the property belongs to us. I have heard our folks, who have lived up there for over a hundred years, say that there was 25 feet of water within 100 feet of the bank.

Col. JUDSON. Well, 1,600 feet out, in 1879, they had 22 feet of water.

Mr. SMITH. Well, it was when we were boys. When that dock was built they had deep water.

Col. NEWCOMER. Maybe we have misdated the time when you were a boy.

Mr. SMITH. That may be, too.

Col. NEWCOMER. We are talking about the conditions in 1879.

Maj. OAKES. There has been a considerable filling in there.

Mr. SMITH. A northerly wind will make it dry. If you will take out the loose stone that is all we ask.

Maj. OAKES. I can take that out without any action from anybody. Let me know where it is.

Mr. SMITH. Then we will have all we want and will not ask for any more.

Maj. **Oakes**. But you mean the submerged dike?

Mr. **Smith**. Yes, sir; that loose stone.

Maj. **Oakes**. I won't agree to take that out. I thought it was loose stone that you were talking about, stone that had fallen off the dike.

Mr. **Browning**. I was told, Major, that we would have to get congressional action to do it.

Mr. **Smith**. It is just stone falling in there.

Maj. **Oakes**. It forms a dike.

Mr. **Smith**. Take the northern part out and it will give us the better water we need. It will wash out that channel.

Maj. **Oakes**. I doubt whether what you want can be obtained by taking out that dike. The dike is necessary for maintaining the deep water in Delaware River.

Mr. **Smith**. We think that it is washing away Petty Island. There is too great a volume of water goes down there, and it is a detriment to properties there. If we have a little more on the Jersey side it will give the city of Camden what is wanted.

Maj. **Oakes**. That is not the way the engineers in charge of the work feel.

Mr. **Smith**. There seems to be a prejudice toward closing that place up.

Maj. **Oakes**. That does not mean that you should not have your 15 or 20 feet of water if you need it. A city like this should be able to develop considerable water traffic. Personally I would be in favor of giving you any depth you require. It seems to me, though, that you should come in below Petty Island. The current that you would get by opening up the submerged dike would not help matters any.

Mr. **Smith**. As boatmen up there, we think it would.

Maj. **Oakes**. The conditions that existed when the dike was not there are not much different.

Mr. **Smith**. We have seen the change in conditions and think with the opening made it would be better.

Mr. **von Nieda**. With all due deference to the major's opinion, I would like to state at this time, gentlemen, that a buoy placed near Petty Island, on the Petty Island side, marking once upon a time 9 feet of water, is to-day in only 2 feet.

Maj. **Oakes**. That may be so, too.

Mr. **von Nieda**. We do know that the channel is shoaling, because by examining the rise of the channel to the shoal part on the side we found that the deposit there is absolutely nothing but soft mud, and we do contend that the erosions from Petty Island, thousands and thousands of cubic yards, because the erosions occur as far as 50 or 60 feet into Petty Island, are in the Philadelphia wharves, and certainly more in our place. Mr. Chairman, we have here to-day the Noecker & Ake Co., practically the second largest shipyard in the city of Camden, and who do a tremendous business in their way, and we would like to have their representatives tell just how they find things.

Mr. **John N. Ake**. Mr. President and gentlemen, I don't know that I can add anything to what already has been said. I looked over the books this morning to see in just what shape we were in the way of getting stuff to our plant. We, of course, indorse what our councilman, Mr. von Nieda, has said in this matter. In regard to a deeper channel in the Delaware River from Cooper River to Fishers Point Dike, on the Jersey side, the back channel, as it were, about 11 years ago, or shortly after that, we were able to come to our dock with four-masted schooners with draft up to 12 to 18 feet, on high tide. At present we are compelled to lighter our lumber on small-draft boats, as we can not come up the channel with a boat drawing more than 10 feet, we think, in coming up to our place at low tide.

Col. **Judson**. You mean in coming up to a point in the channel opposite your place?

Col. **Abbot**. Or to your wharf?

Mr. **Ake**. Not to our wharf. This has been one of our greatest handicaps.

Col. **Abbot**. Before you were speaking of 18 feet at high water, and now you say you can not come in with 10 feet at low water. There is a difference in the way you said it.

Mr. **Ake**. Eighteen feet at high water was correct.

Maj. **Oakes**. With 6 feet of tide; that makes 12 feet at low water.

Mr. **Ake**. There seems to be trouble in getting them up there now. We can not charter a vessel to come up. That is the evidence. One fellow came up there and could not turn around.

Maj. **Oakes.** Two feet difference is a very natural shoaling and is probably what has taken place.

Mr. **Ake.** As late as last May we had 4,000,000 feet of yellow-pine lumber coming up from Texas. It had to be lightered in and handled by hand.

Col. **Judson.** How much did that boat draw that came from Texas?

Mr. **Morris E. Noecker.** Twenty to twenty-two feet.

Col. **Judson.** It never could get in. Vessels draw more than they used to.

Mr. **Noecker.** Well, steamers do.

Maj. **Oakes.** Couldn't you charter a vessel to come up from Texas drawing 12 feet?

Mr. **Noecker.** No, sir.

Maj. **Oakes.** What do they draw—18 or 20 feet?

Mr. **Noecker.** Yes, sir.

Maj. **Oakes.** Well, what you want, then, is 20 feet in there.

Mr. **Noecker.** Well, when it comes to the dredging, Mr. Ake will speak of that. We have dredged considerable. In 1905 we dredged at our wharf, where we used to get our vessels, 100 by 200 feet.

Maj. **Oakes.** How deep?

Mr. **Noecker.** To 26 feet at high water. Four years later we had to do it over. It filled in 5 feet. Of course, it was deeper than the channel. We had more water then—as much as they have in Philadelphia Harbor—right at our wharves, but four years later we had to do it all over again and dredge it out. It filled in 5 feet. We went 100 feet farther out and 100 feet wide. That made it then 400 feet long by 100 feet wide, 26 feet deep at high water. It is always filling in, as these gentlemen all stated. It is filling in more than it used to. Years ago we could get in there with a schooner.

Maj. **Oakes.** Did you do any dredging years ago, before the Fishers Point Dike was there?

Mr. **Ake.** No, sir; not before that.

Maj. **Oakes.** Well, you never had a basin 26 feet deep.

Mr. **Ake.** No. I want to ask the question: In your opinion, with that dike where it is to-day, if we were to dredge out to the channel, don't you think it would fill up more quickly? That is the reason we have been afraid to dredge it out.

Maj. **Oakes.** Not any quicker than it would before. The flood and ebb tides are now passing up and down there. Your dredged channel would be perpendicular to the flood and ebb tides, and it would fill up with those tides running across it quicker than if it was still water. I think there would be less filling in your slip if the dike were completely closed.

Col. **Abbot.** Up above high water, so as to make no current.

Mr. **Ake.** We could not live up there at all if that dike was closed. It would freeze up there in winter.

Maj. **Oakes.** Freeze?

Mr. **Ake.** We could never get out in winter. It would freeze to the bottom sometimes, with the ice backing up in there.

Col. **Abbot.** That is a point that has not been brought out at all.

Maj. **Oakes.** There is something in that.

Mr. **Ake.** That is why we are objecting. When you say that it would not fill in any more—look at the way it has filled in down at Coopers Creek. It seems to have filled in there so that they had to put out some kind of a dike.

Col. **Judson.** Was this dike ever completely closed up and raised above high water?

Maj. **Oakes.** No; it never has been closed. The gap of 300 feet was left originally.

Mr. **L. D. Shuman**, assistant engineer. There was a gap of 300 feet left, and in 1910 we dredged it to 15 feet and took out a few random stone.

Mr. **Ake.** If we had any assurance that we would not have to dredge out every year, that is what we would like to have done.

Maj. **Oakes.** I think you should first get a harbor line established and extend your piers out to the harbor line. Then it seems to me the Board of Engineers would be willing to give you any depth needed.

Mr. **Ake.** That is one of the points I am very glad to hear you express yourself on.

Maj. **Oakes.** I don't want to have the board hold the idea that this district, representing the Engineer Department, is willing to have that Fishers Point Dike opened 1,200 feet wide, as somebody proposes, because it is essential to the maintenance of the deep water in the main channel. Now, then, if you can get your channel without opening that dike any farther—you can certainly get your channel without opening the dike—you can dredge any channel you want up there and maintain it. It is only a matter of money. If you people can show the necessity for more depth, the Government will give it to you.

Mr. **Ake.** It seems to me certainly a benefit to the north shore if the dike was removed, because we can not get sufficient water at times. The dike takes the water away from us and throws it over on the Philadelphia side.

Mr. **Noecker.** That is why it has filled in.

Maj. **Oakes.** But it has not filled in.

Mr. **Noecker.** I have been on that shore for 18 years. When I first came there we used to take scows from our yard, upside down, right opposite our shipyard, out in the channel, and turn them around, right side up. At the present time we take them up just inside Fishers Point Dike and turn them. That is the only place we can turn them. We take them up bottom up, and right them there. We could not begin to do it anywhere but there. I am speaking of a 24-foot beam boat.

Col. **Abbot.** It would draw about 18 feet.

Mr. **Noecker.** They draw about 12 feet upside down. To turn them right side up you have to have pretty near the depth of the beam. We tried it a year ago anywhere between our yard and the Fishers Point Dike, and there was no such a thing as doing it.

Col. **Abbot.** Don't you need a current to capsize your scow?

Mr. **Noecker.** You have to have the water.

Col. **Abbot.** And the current to pull against.

Mr. **Noecker.** We have not got the water down below.

Col. **Newcomer.** Right opposite Cooper Creek there is a deep hole.

Mr. **Noecker.** Yes; at the mouth of Cooper Creek.

Mr. **von Nieda.** Mr. Chairman, we certainly want to bring out every point, because this is vital to us. We have with us one of the largest property owners along that line, Mr. T. L. Bear.

Mr. T. L. **Bear.** Mr. Chairman, the depth of water on the north shore in front of our property is getting more shallow. I went up there about 25 or 30 years ago, when I could have located at other places along Camden's water front, which now have good water. In the last two or three years I have attended these meetings that have been held. I have gotten thoroughly disgusted with the whole business. It has cost me thousands of dollars. We can not sell or rent our property only for a boathouse, or something like that. Inquiries have been made from time to time by parties desiring to locate industrial plants, and they wanted to know what the depth of water was. I told them to go up and see. They went up and I heard no more from them. Others have sent people over and pronounced it no good. The only trouble is lack of deep water.

Col. **Newcomer.** Where is your property, Mr. Bear?

Mr. **Bear.** It begins at Thirty-sixth Street and goes to the neighborhood of Thirty-second Street.

Col. **Newcomer.** Oh, yes.

Mr. **Bear.** When I bought it, or about that time, there was a good depth of water. You could bathe there any time. The bottom used to be all gravel, with plenty of water. Now it is nothing but mud. That property is virtually no good. If we had an approach to get to it, if the stone pile was taken out so that they could come through, I feel that it would clean the channel out and put that property in the market. These shipyards that have been coming around Camden have been making inquiries from us all the time. The inquirers went up and looked at the place. That was the end of it. I bought that place for investment. I could have bought down by Kaighns Avenue for the same price or less, but I selected the north shore because it had a hard gravel beach and bottom. A sugar refinery could be built there without foundations. We have had the place sounded several times and found it good. We would like some improvement made there in regard to the approaches. The gentleman says that they can come around the other way. If you ever came around the other way with a tugboat, or as the Cramer Hill ferry has done, you would find they had to go down pretty near to Arch Street to get up that back channel. The shoaling from the island runs away down.

Col. **Judson.** Have you bought the riparian land out to the channel?

Mr. **Bear.** We have the lease, with the privilege of buying the rights.

Col. **Judson.** How long ago did you get the lease?

Mr. **Bear.** I can't tell exactly. I suppose 8 or 10 years.

Col. **Judson.** Is it worth less now than then?

Mr. **Bear.** I don't know what it is worth.

Col. **Judson.** Have you any objections to telling us what valuation it was based on, what it was worth 10 years ago?

Mr. **Bear.** I can't say that.

Col. **Judson.** You would not like to tell?

Mr. **Bear.** I would like to get my money out of it.

Col. **Judson.** You could abandon that lease at any time.

Mr. **Bear.** We have kept the interest paid on it.

Col. **Judson.** But you could abandon it?

Mr. **Bear.** Yes; I could have, but I have not.

Col. **Judson.** So it must have increased in value.

Mr. **Bear.** I don't think it has.

Col. **Judson.** You could have abandoned it and bought it in again for a lower price if it has depreciated.

Mr. **Bear.** I don't know about that. That is something I don't know. I would like to get back what it cost me. I have held it for a number of years and can't do anything with it. Everyone wants water. If we could get there, there would be enough water. We had a wharf with 4 or 5 feet of water at the end of it; now at low tide there is no water. I know there has been 25 or 30 feet of water in that channel. Many a time I sounded it from the Cramer Hill ferryboat, and sounded it at different times. The place is filling up. At the approach to our property from below there is no water.

Col. **Judson.** This is true, is it not, that if they were going to fill that land out to the channel, they would have gained by this deposit that has been made; you would have less filling to do?

Mr. **Bear.** That is very true. It would not cost much to fill that place in. You could fill it easy enough. One time we got it filled for nothing.

Col. **Judson.** You do think that if there was a channel up there you would fill it in?

Mr. **Bear.** No; we would not. If there was more approach to it, we would. There is no use in having an improved frontage with no approach to it.

Col. **Judson.** You are 1,200 feet back from the channel?

Mr. **Bear.** I think 1,100 feet one way and 1,500 feet the other.

Col. **Judson.** You could not very well use your property without filling in that land?

Mr. **Bear.** Yes; but the channel is filling in at the same time.

Col. **Judson.** You will be satisfied as long as the channel does not fill in?

Mr. **Bear.** I would rather put piling there and fill it in than have the mud come in. There is mud there now over my head. The property is no good for bathing purposes.

Mr. **von Nieda.** Mr. Chairman, it is very true what Mr. Bear has said. We can substantiate all that he says about the property having been destroyed, as far as its riparian value is concerned. That dike we knew, in the first place, would do harm; we knew that the dike would do what it has done. We do believe that the low-water dike—the stone pile, as we are pleased to call it—has been practically responsible for the elimination of Mr. Bear's land from any market whatsoever. A number of years ago I tried to get the location of an industry that would have eventually brought to Camden every year two hundred and fifty to three hundred thousand dollars in pay rolls, and Mr. Bear's land was eliminated by the first look over.

In closing our argument, Mr. Chairman and gentlemen, we want to call upon our mayor first, of course; but I want to say that we do ask you to give us this consideration, because we ask this time for the very life of that place. It is not merely pleading for an improvement which we think might come true, but we know it will come true if you look at it in the proper light. I don't want to say that I know what is best. You gentlemen and those in charge are the true experts, and I know that you will consider the best thing for us when you make your decision, and we hope you will give us what we want. Above all things, I want you to give all the consideration possible to this low-water dike, because we feel that there is where the trouble lies. We have had the opinions of hydrographic engineers; we made hundreds of soundings and examinations—hundreds of them—and we have come to the conclusion that that low-water dike, and with all due deference to Maj. Oakes, that dike is prejudicial to the channel.

I now have the great pleasure of introducing Mr. Charles H. Ellis, mayor of the city of Camden, who will tell you of his interest in this case.

Hon. Charles H. Ellis. Mr. Chairman and gentlemen, when I came in this afternoon I informed Mr. von Nieda that a certain engineer informed me a couple of years ago that it was much better to hear from those who were interested, so far as their business was concerned, than some of the politicians or the chief executive and his assistants, who really did not know what their people wanted at times. I have not forgotten that, and that is why I asked him to keep me until the last. We have had many complaints about the conditions around the north shore, and we feel that, while Philadelphia has her rights—we grant that—our interests are mutual. We are always glad to help Philadelphia, and we can say that she has always tried to help us, but we think that some years back they kind of got a little bit the best of us. Of course, they don't want to take that dike out, because it is keeping the deep water on the other side. This city is growing in leaps and bounds. We are not asking to take away from our great sister city anything that she has, but we are asking for the consideration that we think we deserve as a near-by city. We feel to-day that it is necessary, and I leave it to the engineers to take out that stone pile and give us the relief that we need. We say that if you do this, if you give us the opening that we ask for and remove that dike, it will be a great benefit that you have done this little community of ours.

Last year we spoke about a fire boat. I said that I would recommend it. We are to-day spending money on our river front, not waiting for the Government to dredge, but in the hope that they will give us a 35-foot channel over to our shores. We know that you gentlemen judge these matters not from your own selfish standpoint, not because they are asked for, but upon the merits of the case. I know that, and I am satisfied to let the matter rest there. If you say that Camden, N. J., is rightfully entitled to at least a deeper channel than she has, then these men who own land along that river front will have some heart to build out to it. When we look at that channel that we have there to-day and we are told that it was 35 feet some years ago it means that somebody has taken our water; somebody on this side is suffering because it was taken away. That is not the proper spirit for either one of us to have. Let us join hands and say that Philadelphia's and Camden's interests are mutual. Let us say to the engineers, "Whatever can be done to help both interests let us do it." I say to-day that we can make great strides if there is any improvement made there.

Not only will Twenty-fifth Street be built out, but we are now endeavoring to find out how much of the street ends we own throughout the city. We have established rights to more than one. We are going to spread out, and are spending money down here, where we don't know that we will ever reap a cent of benefit. We know that if we can't get the real business from the other side, why, we will take the overflow. That means that we will put the city of Camden on the map with Philadelphia, so far as warehouses and wharves to take care of large vessels are concerned. If you can see your way clear to help us and give us an adjustment, give us a deeper channel, I will guarantee that the business men and those owners of properties up there will improve them, and I will stake my word of honor from past dealings with them. We are a little helpless community of a hundred and five thousand people. We are spending money to improve our city and are looking forward to a great revenue from our river front in the years to come to lighten the burden of our taxpayers. I thank you for deciding to come back and see us again. Our Congressman, Mr. Loudenslager, has met with you. We are glad to have a Representative like Mr. Loudenslager to help us out. We are glad to know that he is in so close touch with you that he can at least have you come and meet with us after you felt that perhaps we had a hopeless case. Perhaps we have shown you to-day that we are in need of a little more. We will rest the case in your hands again and thank you for giving us this opportunity to present our case.

Mr. Bear. I understood that several years ago, when there was a meeting in the board of commerce room in Philadelphia, Col. Zinn assured me and the rest of the people that were there that they would take the stone pile out of there with the appropriation that was made by Congress for the deep waterway from the sea to Trenton, and that no further appropriation would have to be made; that that appropriation would pay for it. It was not done by the Government at that time. The dredge *Hell Gate* removed a few feet of it. I think the money ought to be available now without any further appropriations.

Mayor Ellis. Mr. Chairman, in the course of my remarks I referred to our friend, Mr. Loudenslager, who passed away. I meant his successor, Congressman

Browning. I never noticed until I sat down that such was the case; but at the same time I only apologize so far as making the mistake in the name, because no Congressman has endeared himself to us more than Congressman Browning has.

Mr. von Nieda. Mr. Chairman, we want to conclude our hearing now, and we want to thank you for your endurance. I know that your board has been suffering to-day to a certain extent, and we do want to thank you for your kindness and your willingness to come here. It was gratifying to us to know that there might have been some sort of an understanding that you have not had heretofore or else you would not have come back. We know that the final judgment of the engineers is very close to being right. We thank you again, one and all, for being here to-day, and I do hope that our friend Maj. Oakes will some time change his opinion about that dike.

Col. Abbot. We are much obliged to you all for coming up here. What we want to do is to get things right, and the only way to do that is to get the facts. We always appreciate it when people come before us and give us a fair presentation of what they want and why they want it.

Mr. von Nieda. That is what we have tried to do. I don't know whether we have succeeded in presenting our case clearly. We have tried to do the best we could, as far as we know. We have given you our figures rather in reserve than exaggeration. I know that the data presented to Col. Zinn on which this recommendation was made is really a conservative statement rather than an exaggeration, and I hope that it will avail us something. I want to submit this statement that was made. It may be of value. Thank you.

The hearing was adjourned at 5.30 p. m.

The following gentlemen were present at the hearing:

On the part of the Board of Engineers for Rivers and Harbors: Col. Frederic V. Abbot, Corps of Engineers, United States Army; Col. Henry C. Newcomer, Corps of Engineers, United States Army; Lieut. Col. Francis R. Shunk, Corps of Engineers, United States Army; Lieut. Col. W. V. Judson, Corps of Engineers, United States Army; Lieut. Col. C. A. F. Flagler, Corps of Engineers, United States Army; Mr. A. H. Weber, assistant engineer.

On the part of the United States engineer office, Philadelphia, Pa.: Maj. J. C. Oakes, Corps of Engineers, United States Army (district officer); Mr. L. D. Shuman, assistant engineer.

On the part of the city of Camden, N. J.: Hon. Charles H. Ellis, mayor; Hon. William J. Browning, Member of Congress; Mr. Frederick von Nieda, councilman; Mr. B. F. Cresson, chief engineer, State board of commerce and navigation; Mr. E. G. C. Bleakley, city counsel; Mr. John Dempsey, in transportation and towing business and property owner; Mr. George Bradley, president of harbor commission of Camden; also representing American Dredging Co., property owners; Mr. Charles Elmer Smith, property owner and president of North Shore Improvement Association; Mr. John N. Ake and Mr. Morris E. Noecker, representing Noecker & Ake Shipbuilding Co., property owners; Mr. T. L. Bear, property owner; Mr. Charles S. Boyer, Mr. John H. Donahoo, Mr. William D. Vanneman, Mr. William D. Sayres, jr.

A large number of other persons were present, but left before their names could be secured.

Stenographic notes of hearing taken and transcribed by H. W. Grant.

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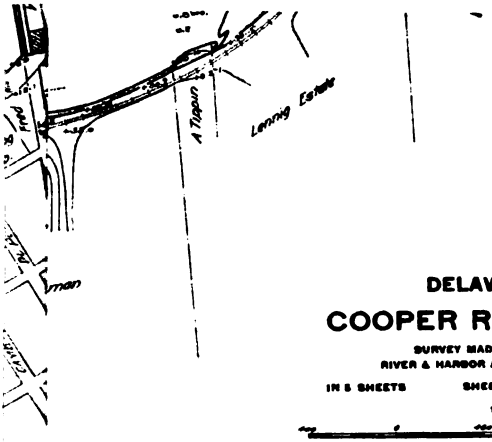

DELAWARE RIVER

COOPER R. TO FISHER PT.

SURVEY MADE UNDER AUTHORITY OF
RIVER & HARBOR ACT APPROVED MARCH 4, 1915.

IN 5 SHEETS SHEET NO. 1.

SCALE OF FEET

U.S. ENGINEER OFFICE. PHILA., PA. APRIL 18, 1916

SUBMITTED:
L. D. Sherman.
ASSISTANT ENGINEER.

SUBMITTED
Geo. A. Zinn
COLONEL, CORPS OF ENGINEERS.

IN CHARGE B.F.
PLOTTED BY J.H. & L.P.G.
CHECKED BY

SURVEYED BY J.H. & W.L.R.
TRACED BY L.P.G.
DATE SURVEYED [illegible] DATED.

NOTED IN BOOK NO. [illegible]
TRANSMITTED WITH REPORT
APRIL 18, 1916.

FILE NO. 37-D-2441

House Doc. No. ; 64th Cong., 2d Sess.

64th Congress, } HOUSE OF REPRESENTATIVES. { Document
2d Session. } { No. 1735.

HARBOR AT PORT O'CONNOR, TEX.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION OF DEEP-WATER HARBOR AT PORT O'CONNOR, TEX.

December 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

War Department,
Washington, December 11, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 1st ultimo, together with copy of a report from Lieut. Col. C. S. Riché, Corps of Engineers, dated June 28, 1916, with map, on a preliminary examination of the deep-water harbor at Port O'Connor, Tex., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Wm. M. Ingraham,
Acting Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, November 1, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination of harbor at Port O'Connor, Tex.

1. There is submitted herewith, for transmission to Congress, report dated June 28, 1916, with map, by Lieut. Col. C. S. Riché, Corps of

Engineers, on preliminary examination authorized by the river and harbor act approved March 4, 1915, of deep-water harbor at Port O'Connor, Tex.

2. Port O'Connor has a population of about 200 and is situated on the west shore of Matagorda Bay at the inner end of Pass Cavallo. The main line of the intracoastal waterway passes about three-fourths of a mile south of the town. Interested parties desire that the channel across the Pass Cavallo Bar be deepened to 18 or 20 feet and extended through the natural channel along Matagorda Island and through Barroom Bay to the north shore of this bay adjacent to Port O'Connor with a suitable turning basin at its terminus. In the opinion of the district officer the country adjacent to Port O'Connor and the territory which might be tributary to it have not yet reached a stage of development which would justify the large expenditure which the improvement desired would entail. He therefore believes that the locality is not worthy of improvement by the Federal Government at the present time. The division engineer concurs in this conclusion.

3. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 25, 1916, concurring in the views of the district officer and the division engineer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of deep-water harbor at Port O'Connor, Tex., is not deemed advisable at the present time.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 25, 1916.

The Chief of Engineers, United States Army:

1. The following is in review of the district officer's report authorized by the river and harbor act of March 4, 1915, on preliminary examination of deep-water harbor Port O'Connor, Tex.

2. Port O'Connor, with a population of about 200, is situated on the west shore of Matagorda Bay at the inner end of Pass Cavallo, an outlet from the bay to the Gulf of Mexico. The main line of the inland waterway along the coast of Texas passes about three-fourths of a mile south of the town. The depth on the bar at the entrance to the pass has ranged between 7 and 10 feet. For some distance inside the bar there is a minimum depth of 38 feet, gradually decreasing as it spreads out into Matagorda Bay. Opposite Port O'Connor the depth is 9 to 12 feet, and in Barroom Bay, a short distance southwest of the port, the depth is 4 to 5 feet.

3. The improvement of Pass Cavallo was undertaken about 1879 with a view to securing a channel depth of 12 feet by the construc-

tion of a single jetty and such auxiliary works as were required. The results were not satisfactory; and after an expenditure of about $292,000, work was discontinued in 1885. The improvement now desired is a permanent channel 18 to 20 feet deep across Pass Cavallo Bar, extending into Barroom Bay, with a suitable turning basin at its terminus near Port O'Connor.

4. There was at one time considerable commerce through this pass, but with the advent of the railroads it began to dwindle, and by 1887 had practically disappeared and has not been revived since. The principal business at present is in fish and oysters, although there is some farming done in the adjacent country. The amount of tonnage handled is not given, but it is apparently small. The district officer is of opinion that the locality has not yet reached a state of development which would justify the large expenditure that would be required to effect the improvement desired. He therefore reports that the harbor at Port O'Connor is not worthy of improvement at this time. The division engineer is in accord with this view.

5. Interested parties were informed of the unfavorable report of the district officer and given an opportunity of submitting statements and arguments to the board, but no communications on the subject have been received.

6. There is at present little commerce at this port and no immediate prospects of a material increase, certainly none sufficient to justify the cost of a deep-water harbor. The inland waterway along the coast of Texas, designed to meet the traffic requirements of small communities lying between deep-water harbors, passes quite near Port O'Connor. This waterway furnishes a route to Galveston, 125 miles to the eastward, and to Port Aransas, 55 miles to the westward. In view of these conditions, the board concurs with the district officer and the division engineer in the opinion that it is not advisable at this time for the United States to undertake the improvement of a deep-water harbor at Port O'Connor, Tex.

7. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other related subjects which could be coordinated with the suggested improvement in such manner as to render the work advisable in the interests of commerce and navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF HARBOR AT PORT O'CONNOR, TEX.

UNITED STATES ENGINEER OFFICE,
Galveston, Tex., June 28, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination, deep-water harbor at Port O'Connor, Tex.

1. In compliance with instructions contained in letter from the Office of the Chief of Engineers dated March 15, 1915, the following

report is submitted on the item contained in the river and harbor act of March 4, 1915, as follows:

> SEC. 15. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities: * * * Deep-water harbor at Port O'Connor, Tex.

2. The field examination was made by Mr. E. B. Sandelands, inspector, from this office, to whose accompanying report[1] attention is invited.

3. Port O'Connor, a town of about 200 inhabitants, is situated on the west shore of Matagorda Bay and the north shore of Barroom Bay (an arm of Espiritu Santo Bay), at the inner end of Pass Cavallo, which is the outlet from Matagorda Bay into the Gulf of Mexico. It is the terminus of the Port O'Connor branch of the St. Louis, Brownsville & Mexico Railroad. The main line of the inland waterway on coast of Texas passes about three-quarters of a mile south of the town, here cutting through the narrow neck of land separating Matagorda Bay and Barroom Bay. The natural connection between these two bays, known as Big Bayou, which was formerly used by the inland waterway, lies about 1¼ miles south of the town. The inland waterway with a project depth of 5 feet at mean low tide and bottom width of 40 feet connects this place with Port Aransas on the west (distant 62 miles) and Galveston and Houston on the east (distant 120 and 182 miles, respectively).

4. There are two channels leading across Pass Cavallo Bar, one a minor channel around the end of Decros Point (the end of Matagorda Peninsula), the other the main one lying to the south along the shore of Matagorda Island. Between these two channels and in the throat of the pass is a group of low sand islands, known as Pelican Islands. The depth on the bar in the main channel has varied from 7 to 10 feet. At the time of the present examination there was a depth of 9 feet at mean low tide. Inside the bar there is a natural channel lying along the shore of Matagorda Island varying from 700 to 1,200 feet in width and with a maximum depth of about 38 feet, gradually shoaling as it spreads out into Matagorda Bay. The depth in this bay abreast of Port O'Connor is from 9 to 12 feet. The depth in Barroom Bay is 4 to 5 feet. The general condition of this pass and surrounding country and Matagorda Bay is shown by Coast Survey chart No. 207.

5. The improvement of Pass Cavallo was at one time an adopted project, and a brush and stone jetty extending out from Matagorda Island was partially built, under a plan proposed by the board of engineers for fortifications and river and harbor improvements in their report dated August 9, 1879. (See Annual Report Chief of Engineers, 1880, p. 1259.) This project contemplated the construction of one jetty upon the south side of the pass and groins, if necessary, to protect the face of Matagorda Island from erosion. The jetty was to be high, 7,600 feet long, and to terminate at the 18-foot curve. Its cost was estimated to be $760,100. It was expected to secure and maintain a channel depth of 12 feet, the natural depth being from 7 to 13 feet. Work was suspended in July, 1885, after about 5,253 feet of foundation course of the jetty had been con-

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[1] Not printed.

structed and a portion of this brought up to finished height of jetty. The total amount expended on this improvement was $292,050.22. In 1887 a survey was made, and it was found that only about 775 feet in length of the jetty was exposed above water, this portion being on shore; 1,710 linear feet had diminished in height from 47 to 85 per cent, and the remaining 2,768 feet had practically disappeared. (See Annual Report Chief of Engineers, 1888, p. 1302 et seq.) As the commerce of this pass had been steadily decreasing since 1872 and by 1887 had practically vanished entirely, and as this locality was dropped from the list of appropriations in the river and harbor act of August 11, 1888, it was recommended by the district officer at that time that no further appropriation be made and that the work be abandoned. This was approved by the Chief of Engineers May 7, 1889, and the improvement of this locality was accordingly dropped.

6. The people who are now interested in the improvement here wish the channel deepened across the Pass Cavallo Bar and extended through the natural channel along Matagorda Island and through Barroom Bay to the north shore of this bay adjacent to Port O'Connor with a suitable turning basis at its terminus. This would give a protected terminus for the harbor, as it would end in a practically landlocked and shoal bay. Two routes were suggested for the channel to be excavated from the natural channel along Matagorda Island to the terminus, one to be through Matagorda Bay to the line of the inland waterway, thence through the bulkhead cut of this waterway through the neck of land between Matagorda Bay and Barroom Bay, and through this latter bay to the turning basin; the other, which would be more direct, through the outer end of Big Bayou and through the intervening marsh land to Barroom Bay and across this bay to the turning basin. A depth of from 18 to 20 feet in the channel and basin was desired. In this connection, attention is invited to the accompanying statement[1] of Mr. C. S. Mitchell, C. E., with reference to improvement of this locality.

7. In former years there was a large commerce through this pass and Indianola on the west shore of Matagorda Bay was at one time the most important port in Texas. The storms of 1875 and 1886, however, destroyed this town, and with the building of railroads into Galveston and improvement of this and other ports on the coast commerce dwindled, and, as stated above, practically disappeared by 1887, and has never been revived. A few years ago the St. Louis, Brownsville & Mexico Railroad extended a branch line and the town of Port O'Connor was established. At present this place has a population of possibly 200 with several stores, a hotel, cotton gin, and two fish and oyster wharves. The principal business done at present is in fish and oysters, although there is some farming done in the surrounding country. Although the main line of the inland waterway passes close to the town it could not be determined that much freight had been carried in or out of this place by this route. Information has been requested of the amount of freight carried in and out by the railroad but has not yet been furnished.

8. Terminals at present consist of one large pleasure wharf and pavilion extending out into Matagorda Bay at the town and two small fish and oyster wharves on Barroom Bay. All these wharves

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[1] Not printed.

have highways leading to them, but are without direct railroad nection. They are privately owned, but are understood to be open to all carriers on equal terms and are sufficient for the present commerce. There is ample room for future wharf development along Barroom Bay and Matagorda Bay. There is no water-power development possible nor any other question that could be considered in connection with the improvement to lessen the cost to the United States.

9. It is believed that the country adjacent to Port O'Connor and the territory behind, and which might be tributary to it, has not yet reached a stage of development which would justify the large expenditure which the improvement desired would entail, especially in view of the fact that Port Aransas lies only about 55 miles to the westward, and the mouth of the Brazos River and Galveston, lie, respectively, only 80 and 125 miles to the eastward, all of which have been improved by the United States and are connected with Port O'Connor by the inland waterway. The continued development of the country will in time probably make an improvement of this character at this place justifiable, but at the present time it is believed that the improvement of a harbor at Port O'Connor, Tex., is not worthy of being undertaken by the Federal Government.

10. There are inclosed herewith detailed report[1] of Mr. E. B. Sandelands, inspector, statement[1] of Mr. C. S. Mitchell, C. E., and sketch map[1] of the locality.

C. S. Riché,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

Office of Division Engineer, Gulf Division,
New Orleans, La., July 6, 1916.

The Chief of Engineers, United States Army:

1. Forwarded, concurring in the views of the district officer. The cost of construction of the harbor desired would be comparable to the cost of the harbor at Aransas Pass, probably even exceeding it, and the present and immediately prospective commerce would by no means justify it.

J. C. Sanford,
Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

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[1] Not printed.

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64th Congress, 2d Session. | HOUSE OF REPRESENTATIVES. | Document No. 1736.

SAMMAMISH RIVER, WASH.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON PRELIMINARY EXAMINATION OF SAMMAMISH RIVER, WASH., FROM LAKE WASHINGTON TO BOTHELL, INCLUDING CONSIDERATION OF ANY PROPOSITION FOR COOPERATION ON THE PART OF LOCAL INTERESTS.

December 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

War Department,
Washington, December 12, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 6th instant, together with copy of a report from Lieut. Col. J. B. Cavanaugh, Corps of Engineers, dated April 22, 1916, on a preliminary examination of Sammamish River, Wash., from Lake Washington to Bothell, including consideration of any proposition for cooperation on the part of local interests, made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Wm. M. Ingraham,
Acting Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, November 6, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination of Sammamish River, Wash.

1. There is submitted herewith for transmission to Congress report, dated April 22, 1916, by Lieut. Col. J. B. Cavanaugh, Corps of

Engineers, on preliminary examination authorized by the river and harbor act approved March 4, 1915, of Sammamish River, Wash., from Lake Washington to Bothell, including consideration of any proposition for cooperation on the part of local interests.

2. The Sammamish River is the outlet of Lake Sammamish and has a length of 17 miles from its source to its mouth in Lake Washington. Boats plying on Lake Washington ascend the river as far as Bothell, a distance of 3 miles, to which point the limiting depths are between 5 and 6 feet at ordinary low water. The district officer states that during 1914 one boat operated from Lake Washington to Bothell and carried 56 tons of miscellaneous freight and 11,402 passengers. Upon the completion of the Lake Washington Canal the lake will be lowered 8 feet below the ordinary summer level, and as a result of this lowering it will be practically impossible to navigate the Sammamish River. To extend navigation to Bothell would then require a large amount of dredging, both for original work and for maintenance. Correspondence accompanying the district officer's report indicates that local interests are not in a position to cooperate with the Government in this matter. He expresses the opinion, in which the division engineer concurs, that the desired improvement would involve an ultimate expenditure greater than appears warranted by the present or reasonably prospective commerce.

3. This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 11, 1916, concurring in the views of the district officer and the division engineer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Sammamish River, Wash., from Lake Washington to Bothell is not deemed advisable at the present time.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

[Third indorsement.]

Board of Engineers for Rivers and Harbors,
July 11, 1916.

The Chief of Engineers, United States Army:

1. The following is in review of the district officer's report authorized by the river and harbor act of March 4, 1915, on preliminary examination of Sammamish River, Wash., "from Lake Washington to Bothell, including consideration of any proposition for cooperation on the part of local interests."

2. The Sammamish River, 17 miles in length, is an outlet of Lake Sammamish and empties into Lake Washington. Bothell is situated about 3 miles from Lake Washington. At ordinary low water the controlling depths on this reach are between 5 and 6 feet. The com-

merce reported for 1914 is 56 tons of freight, in addition to which 11,402 passengers were carried.

3. The project for the Lake Washington Canal contemplates the lowering of the lake 8 feet below the ordinary summer level or 6½ feet below the lowest observed level. Sammamish River will then become unnavigable and will be simply a drain. There has been no offer of local cooperation. To carry a navigable depth from Lake Washington to Bothell after the lake has been lowered would require extensive dredging, involving a larger ultimate cost than the district officer believes to be warranted by present or reasonably prospective commerce. The division engineer is in accord with this view.

4. Interested parties were informed of the unfavorable report of the district officer and given an opportunity of submitting statements and arguments to the board. No communications on the subject have been received, but on June 20, Hon. W. E. Humphrey, M. C., and Hon. L. H. Hadley, M. C., came before the board in the interests of the citizens of Bothell.

5. Under existing conditions, although there are depths of 5 to 6 feet up to Bothell, there is very little water-borne tonnage. After Lake Washington has been lowered, navigation will not be possible unless a dredged channel is carried from deep water in the lake to the head of the proposed navigation. This is obviously not warranted by probable benefits. It was stated at the hearing[1] that the people of Bothell had always had navigation facilities, and that the proposed operations of the Federal Government in connection with the Lake Washington Canal would deprive them of these advantages and that in equity some compensatory provision should be made, either through a dredged channel or a lock and dam. In this connection it may be stated that the Lake Washington Canal was undertaken with the provision that King County or other local agency would secure the United States from liability for any claims or damages on account of the lowering of the level of Lake Washington. Moreover, the country above Bothell is low and swampy, and very material benefits are expected from the better drainage that will follow the lowering of the lake. In view of the foregoing, the board reports, in concurrence with the views of the district officer and the division engineer that it is not advisable for the United States to undertake the improvement of Sammamish River, Wash., from Lake Washington to Bothell.

6. In compliance with law, the board reports that there are no questions of terminal facilities, waterpower, or other related subjects which could be coordinated with the suggested improvement in such manner as to render the work advisable in the interests of commerce and navigation.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

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[1] Not printed.

PRELIMINARY EXAMINATION OF SAMMAMISH RIVER, WASH.

War Department,
United States Engineer Office,
Seattle, Wash., April 22, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Sammamish River, Wash., from Lake Washington to Bothell.

1. In compliance with section 15, river and harbor act of March 4, 1915, and instructions contained in your letter of March 4, 1915, the following report, with map,[1] is submitted on a preliminary examination of Sammamish River from Lake Washington to Bothell, Wash., including consideration of any proposition for cooperation on the part of local interests.

2. The Sammamish River has been previously examined by a board of officers appointed under the act of Congress of September 19, 1890, in connection with a proposed ship canal to connect Lakes Union, Washington, and Sammamish with Puget Sound. The report of this board was published in annual report of the Chief of Engineers for 1892, page 2762, and is unfavorable.

3. The river was the subject of a preliminary examination in 1911. The report was published in House Document No. 1062, Sixty-second Congress, third session, and is unfavorable.

4. The Sammamish River is the outlet of Lake Sammamish, flows from the northwestern end of this lake northward and westward, and empties into the northern end of Lake Washington. Its channel is very tortuous, the distance from source to mouth along the stream being 17 miles, while the distance in a straight line does not exceed 10 miles. The width of the river varies between about 50 and 150 feet, and the current is sluggish at all times, except in the drainage ditch in the upper portion. The principal towns along the stream are Redmond, about 2 miles from Lake Sammamish, and Bothell, about 3 miles from Lake Washington. Between Bothell and deep water in Lake Washington limiting depths are between 5 and 6 feet at ordinary low water in Lake Washington.

5. Lake Washington boats ascend the river as far as Bothell, a distance of 3 miles. During 1914 one boat, of 29 net tons, operated from Lake Washington to Bothell and carried 56 tons of miscellaneous freight and 11,402 passengers.

6. Upon the completion of the Lake Washington Canal, Lake Washington will be lowered 8 feet below the ordinary summer level, or 6½ feet below its lowest observed level, and as a result of this lowering it will be practically impossible to navigate the Sammamish River.

7. The Northern Pacific Railway operates two lines, one paralleling the Sammamish River throughout its length, the other crossing it at Woodinville, a small town about 3 miles upstream from Bothell. Main lines, one passing east of Lake Washington and one passing around the northern end of Lake Washington through Bothell, join at Woodinville and extend to Sumas, near the inter-

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[1] Not printed.

national boundary. From Woodinville a branch line extends along the Sammamish River through Redmond to points on the eastern shore and to a short distance east of Lake Sammamish. A public wharf, adequate for all needs, is maintained at Bothell. Landings at other points along the river are made at suitable places along the banks.

8. After Lake Washington is lowered the Sammamish River will lose all importance, as far as navigation is concerned, and will become practically a drainage ditch for Lake Sammamish. To extend Lake Washington, when lowered, to Bothell will require a large amount of dredging; and such a channel, if made, would be subject to serious deterioration, especially while the stream bed above was adjusting itself to the new slope, and would always require dredging for proper maintenance. Considering both first cost and maintenance, such a waterway would involve an ultimate expenditure greater than appears warranted by the present or reasonably prospective commerce.

9. The question of local cooperation in dredging a channel from Lake Washington to Bothell was taken up by correspondence with the Bothell Commercial Club, and developed the fact that local interests are not in a position to cooperate with the Government in this matter. Letters from the Bothell Commercial Club, dated April 3 and 17, 1916, are submitted herewith, marked "Exhibit A."

10. An excellent paved highway connects Bothell with Seattle, and if connection by water is found necessary the most feasible and economical method of securing it would seem to be by the construction of a suitable landing place for Bothell near the northern end of Lake Washington at some point on this highway.

11. In compliance with law, I have to report also that it is not practicable to coordinate with any improvement of Sammamish River, Wash., either flood protection or the development and utilization of water power for commercial purposes so as to reduce the cost of improvement.

J. B. Cavanaugh,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

Northern Pacific Division,
Portland, Oreg., April 24, 1916.

The Chief of Engineers, United States Army.

1. Forwarded, concurring in the views of the district engineer as expressed in paragraph 8.

Chas. L. Potter,
Lieutenant Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors see p. 2.]

Exhibit A.

LETTER OF THE PRESIDENT OF THE BOTHELL COMMERCIAL CLUB.

Bothell, Wash., *April 3, 1916.*

Dear Sir: Your letter to Bothell Commercial Club, under date of March 28. has been handed to me to answer.

So far we have been unable to organize for the purpose of cooperating with the Government in the matter of dredging from Bothell to the lake. It is felt by the local people that the property owners along the channel who will be directly benefited by this improvement should take the lead, especially in the way of financing it. So far, to our disappointment, they have failed to do so. We make another attempt to get something definite done along this line next Monday evening, and I will report to you the result of such effort.

Yours, truly,

CHAS. V. BEARDSLEE.

Capt. A. R. EHRNBECK,
Corps of Engineers.

LETTER OF THE PRESIDENT OF THE BOTHELL COMMERCIAL CLUB.

BOTHELL, WASH., *April 17, 1916.*

DEAR SIR: In your favor of the 15th instant you ask if you are correct in assuming that local interests are not in a position to cooperate with the Federal Government in any work in the Sammamish River.

At the present time, from a financial viewpoint, such an assumption is correct.

The sentiment here is that the Government can not legally nor morally destroy our waterway which nature has given us.

Until recently I have felt that local interests would contribute toward any improvement the Government might make on this channel, but as the time approaches for action I find that such is not the case.

Yours, truly,

CHAS. V. BEARDSLEE,
President Bothell Commercial Club.

Lieut. Col. J. B. CAVANAUGH,
Corps of Engineers.

LETTER OF THE SECRETARY OF THE BOTHELL COMMERCIAL CLUB.

BOTHELL, WASH., *June 12, 1916.*

DEAR SIR: I have the honor, in behalf of the Bothell Commercial Club, of replying to your letter of recent date to Mr. J. C. Gregory in re the Sammamish River improvement.

We understand that the engineer has made an adverse report on dredging the Sammamish River up to Bothell after the lowering of Lake Washington has taken from us a navigable stream.

We most earnestly protest against the adverse report as unfair and unjust to this community for the following reasons:

First. From the time of the earliest settler the river, being a navigable stream, has furnished the easiest, cleanest, cheapest, and shortest route to Seattle.

Second. The fact that we had this route has been the deciding factor in bringing to us many of our best citizens.

Third. While to those directly on the river bank the lowering of the water will give better land drainage, yet to those living farther back, who have been taxed, a great injustice has been done—a very great injustice—by depriving them of a natural transportation route, a navigable river.

Fourth. The destruction of this river as a navigable stream will amount to a confiscation of property, for additional value has been given our land because of the fact that we had a very convenient route.

We trust that this presentation of our claims will enable you to secure favorable action.

Thanking you for your efforts, I am,

Very truly, yours,

W. E. NEMS,
Secretary Bothell Commercial Club.

Hon. L. H. HADLEY,
House of Representatives.

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64th Congress, 2d Session. | HOUSE OF REPRESENTATIVES. | Document No. 1737.

SABINE-NECHES CANAL, TEX.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF SABINE-NECHES CANAL, TEX., WITH A VIEW TO REVETTING THE NORTH BANK OF THE CANAL BETWEEN PORT ARTHUR, TEX., AND SABINE LAKE, SUCH REVETMENT WORK TO BE CONFINED TO THE SECTION OF THE BANK WITHIN THE CITY LIMITS OF PORT ARTHUR, TEX.

December 13, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

War Department,
Washington, December 12, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 1st ultimo, together with copies of reports made by Maj. (now Lieut. Col.) W. J. Barden, Corps of Engineers, dated October 18, 1915, and April 10, 1916, with map, on a preliminary examination and survey, respectively, of Sabine-Neches Canal, Tex., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Wm. M. Ingraham,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, November 1, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Sabine-Neches Canal, Tex.

1. There are submitted herewith for transmission to Congress reports dated October 18, 1915, and April 10, 1916, with map, by Maj. (now Lieut. Col.) W. J. Barden, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act approved March 4, 1915, of Sabine-Neches Canal, Tex., with a view to revetting the north bank of the canal between Port Arthur, Tex., and Sabine Lake, such revetment work to be confined to the section of the bank within the city limits of Port Arthur.

2. The present project for improvement of the Sabine-Neches Canal, adopted by the act of February 27, 1911, and modified by the river and harbor acts of 1912 and 1915, provides for a waterway 25 feet deep throughout, and of varying widths, from the Port Arthur Ship Canal inside the northwest bank of Sabine Lake to the mouth of the Sabine River, the Neches River up to the town of Beaumont, and the Sabine River up to the town of Orange. Expenditures on the project to June 30, 1915, amounted to $1,051,869.48, of which one-half was contributed by the navigation districts of Orange and Beaumont. The project has been practically completed. There has been some erosion of the north bank of the canal, and the improvement desired is the protection of this bank within the city of Port Arthur, with a view to preventing further encroachment on abutting property, and to insure the safety of a levee which the city authorities propose to build along the bank of the canal for protection against floods. Estimates are presented for several types of revetment, ranging in cost from $57,000 to $165,000. The district officer reports that while further erosion of the bank may be expected if it is not protected, the benefits from such protection have too remote a bearing upon navigation to warrant the United States in undertaking the improvement with river and harbor funds. The division engineer is of opinion that the cost of even the least expensive plan is larger than the benefits to be derived would justify.

3. These reports have been referred, as required by law to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated July 11, 1916, concurring in the views of the district officer and the division engineer.

4. After due consideration of the above-mentioned reports, I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Sabine-Neches Canal, Tex., with a view to revetting the north bank of the canal between Port Arthur, Tex., and Sabine Lake, such revetment work to be confined to the section of the bank within the city limits of Port Arthur, is not deemed advisable at the present time.

W. M. BLACK,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
July 11, 1916.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following is in review of the district officer's reports authorized by the river and harbor act of March 4, 1915, on preliminary examination and survey of Sabine-Neches Canal, Tex., with a view to revetting the north bank of the canal between Port Arthur, Tex., and Sabine Lake, such revetment work to be confined to the section of the bank within the city limits of Port Arthur.

2. The Sabine-Neches Canal extends from the head of the Port Arthur Canal inside the west bank of Lake Sabine through the town of Port Arthur to the mouths of the Neches and Sabine Rivers and up the latter to Orange and the former to Beaumont. The depth is 25 feet and the bottom width 90 to 150 feet. It is practically complete. To June 30, 1915, the cost had been $1,051,869.48, of which amount one-half was contributed by the localities of Orange and Beaumont. The ordinary tidal range is 1 foot, but due to storms the extreme range is as great as 8 feet. The distance within the city limits following the line of the canal is 19,000 feet.

3. The improvement desired is the protection by revetment of the north bank of the canal within the city of Port Arthur, where it has been subject to erosion to the extent of encroaching upon private or city property outside the line of right of way. The need of such an improvement has been increased by the recent decision of the city authorities to surround the city by a levee with a view to protection from such floods as the one caused by the hurricane of August, 1915. It is proposed to run the levee as close as practicable along the bank of the canal, and the revetment is desired with a view to preventing further encroachment on abutting property and securing the safety of the levee.

4. The commerce of the canal for 1914 is reported as 679,319 tons, valued at $3,607,957. This, however, belongs largely to Orange and to Beaumont, there being little commerce on this canal pertaining to the city of Port Arthur.

5. In a communication quoted by the district officer in his report of survey local interests have modified their request for improvement by reducing the length of revetment from 19,000 feet to approximately 11,300 feet, which would be sufficient to cover the most pressing needs.

6. The district officer presents plans for three types of creosoted-timber revetment and for a concrete-pile revetment of this length, the estimates ranging from $113,000 for the cheapest timber revetment to $165,000 for the concrete revetment, which he thinks would be the most economical form in the long run. In view of the high cost of these forms of revetment and the belief that a less expensive structure would serve the purpose, the division engineer secured estimates for a simpler type consisting of a loose-rock toe laid in a trench, above which on a slope of 1 on 2 is to be placed a layer of riprap covered with concrete grout. This revetment is estimated to cost $57,000. The district officer reports that while further caving of the bank may be expected if not protected, the benefits from such revetment have too remote a bearing upon navigation to warrant the United States

in undertaking the improvement with river and harbor funds. The division engineer recommends that if the improvement is to be made the less expensive type be selected. He is of opinion, however, that the cost of even this type would be larger than the benefits would justify.

7. Interested parties were informed of the unfavorable reports of the district officer, both on preliminary examination and survey, and given an opportunity in each case of submitting their views as to the advisability of the United States undertaking this work. These notices resulted in hearings at this office on February 23, 1916, attended by Hon. Morris Sheppard, United States Senate, and two persons from the locality, and again on June 20, 1916, attended by Hon. Morris Sheppard, United States Senate, Hon. Martin Dies, Member of Congress, and a representative from the locality.

8. It is apparent from the information now available that the north (northwest) bank of the canal within the city of Port Arthur has been eroding and is now encroaching upon private and city property outside the United States right of way. It is also apparent that erosion will continue to some extent unless it is checked by some form of revetment. This erosion does not seriously impede or injure navigation, and any material washed in could be removed by dredging at much less cost than that of the revetment required to prevent the erosion. It is a well-established principle that the United States is not responsible for incidental damages to riparian property due to works of improvement in a natural waterway. It is true that this portion of the Sabine-Neches Canal is an artificial waterway, but it was given its present location through the land, instead of in the lake, at the solicitation of local interests and on the condition that the right of way should be furnished free of cost to the United States. Moreover, it appears that the lake shore was being eroded by wave action at the rate of 10 to 12 feet a year before the canal was built, so that the result of the canal construction, with its embankment on the lake side, has probably been to diminish the natural caving of the bank.

9. It is clear that the desired revetment is not required for the protection of the interests of navigation, and after careful consideration it appears questionable to the board whether the riparian owners have any legal or moral grounds for demanding relief at the expense of the United States, as an incident to its work of navigation improvement. The board therefore concurs with the district officer and the division engineer and reports that in its opinion it is not advisable for the United States to undertake the improvement of the Sabine-Neches Canal, Tex., with a view to revetting the north bank of the canal between Port Arthur, Tex., and Sabine Lake, such revetment work to be confined to the section of the bank within the city limits of Port Arthur.

10. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects which could be coordinated with the project proposed in such manner as to render the improvement advisable in the interests of commerce and navigation.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF SABINE-NECHES CANAL, TEX.

United States Engineer Office,
Dallas, Tex., October 18, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Sabine-Neches Canal, Tex., with a view to revetment in front of Port Arthur.

1. The following report is submitted on Sabine-Neches Canal, Tex., with a view to revetting the north bank of the canal between Port Arthur, Tex., and Sabine Lake, such revetment work to be confined to the section of the bank within the city limits of Port Arthur, as called for by the river and harbor act of March 4, 1915, and referred to this office by department letter of March 15, 1915.

2. Under a project for improving mouths of Sabine and Neches Rivers, Tex., adopted by the river and harbor act of March 3, 1905, a channel 100 feet wide and 9 feet deep at mean low Gulf level, was constructed through the land near Sabine Lake from the mouths of the Sabine and Neches Rivers to the mouth of Taylors Bayou. Under the provisions of the river and harbor act of March 2, 1907, this channel was widened 75 feet for a distance of 1,500 feet in front of the lower part of Port Arthur, and extended at its southern end to a junction with the Port Arthur Ship Canal. This work was completed in May, 1908. The total amount expended on this project to July 1, 1915, was $524,536.03.

3. Under provisions contained in the river and harbor acts of February 27, 1911, and July 25, 1912, the above-described project was superseded by one for "Improving the Sabine-Neches Canal, Texas, from the Port Arthur Ship Canal to the mouth of the Sabine River, the Neches River up to the town of Beaumont, and the Sabine River up to the town of Orange * * *," which provides for a waterway from the Port Arthur Ship Canal to Beaumont and Orange with 25 feet depth at mean low Gulf level throughout, and bottom widths as follows: In the canal from the Port Arthur Ship Canal to Sabine River 90 feet through the land, suitably widened where it enters the rivers, and 115 feet where it crosses the open lake between the mouths of the Sabine and Neches Rivers; in open rivers, 150 feet; in the two cut-offs in the Neches River at Mansfield Ferry and Snaggy Bend, 90 feet; in the cut-off in the Sabine River, 210 feet. It further includes a guard lock 80 by 600 feet, with a depth of 28 feet over miter sills, 6 miles above Port Arthur; three passing points 110 by 1,700 feet in the canal below the Neches River; a turning basin 500 by 1,500 feet at Beaumont, and one at Orange. This project is completed except the guard lock, but the available depth is limited to that in the bypass around the lock, viz, 9 feet. The total amount expended to June 30, 1915, was $1,051,869.48, one-half of which was contributed by the localities of Orange and Beaumont.

4. The channels of approach from the Gulf of Mexico are Sabine Pass and the Port Arthur Ship Canal, through both of which there is a navigable depth of 25 feet at mean low Gulf level.

5. The only bridge is that across the Sabine-Neches Canal at Port Arthur, which is of the bascule type with clear width of opening between piers of 90 feet.

6. The ordinary tidal range in the canal at Port Arthur is 1 foot. Extreme range due to storms has been as great as 8 feet.

7. The accompanying map, prepared from the survey for the construction of the canal, shows the canal from its lower end to above the town of Port Arthur. The city limits extend from about station 101 to about station 291, a total distance of 19,000 feet. Cross sections of the canal in 1907, 1913, and 1915 at typical points along the city front also are shown. The locality is also shown on Coast and Geodetic Survey Chart No. 517.

8. There has been no previous examination ordered by Congress of this locality with a view to the revetment of the bank.

9. A duly advertised public hearing was held at Port Arthur August 5, 1915, for the purpose of giving interested persons an opportunity to express their views on the proposed improvement. The meeting was well attended. A full report[1] of the hearing, including all papers submitted, accompanies this report.

10. The improvement desired is the protection, preferably by a permanent concrete revetment, of the north bank of the canal for the full length of the city limits. The following extracts from letters presented at the hearing give the desires of those interested and the arguments advanced for the improvement:

From letter of the Board of Trade of Port Arthur, Tex., by Mr. G. H. Eubank, president:

> In the matter of the revetment of the west bank of the Sabine-Neches Canal, I wish to state that this bank has encroached upon the city parks and other property adjacent thereto as much as 30 to 32 feet, and my opinion is that the peculiar formation of the soil along the greater portion of this bank, especially at the north end of the city, will go on more rapidly in the future than it has in the past.
>
> This soil, about 3 or 4 feet in depth, is alluvial, and at high tides it becomes saturated with water and the rapid passing of vessels causes it to continually sluff off down to the clay and fall into the canal. There is nothing to prevent this bank from falling in for a distance of from 200 to 300 feet, because in high tides and rises in the rivers the canal is nearly bank full and the action of the waves will continue to wear away the alluvial soil.
>
> The city parks, the Methodist Episcopal Church school property, the public-school property, and the hospital practically own and control all of this front.
>
> I feel that the rapid growth of the city and the importance of the parks and the school property and the hospital demand that a permanent concrete revetment be constructed that will prevent further encroaching of the canal on the properties above mentioned.

From letter of Mr. Jan Van Tyen, general manager Port Arthur Townsite Co., general manager Port Arthur Land Co.:

> * * * This revetment work is not so much a necessity to improve commerce and navigation conditions, but is necessary to preserve property that belongs to different owners, and principally to the city of Port Arthur.
>
> As general manager of the Port Arthur Land Co. and the Port Arthur Townsite Co., I visited Washington in December, 1905, and through our attorney, R. A. Greer, the Port Arthur Townsite Co. and the Port Arthur Land Co., in connection with the city of Port Arthur and other owners of water front, offered to the United States Government free right of way for the Sabine-Neches Canal, and deeds were executed to the United States Government as soon as the field notes had been furnished by the engineers.
>
> These field notes described a certain line, and it was the intention that all property on the east of this line would belong to the United States Government for canal purposes. In this deed from the Port Arthur Townsite Co., dated February 3, 1906, the Government "reserved the right to improve and protect

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[1] Not printed.

the northwesterly bank of said channel." This deed mentioning these words was made up in Washington and sent to Port Arthur for the signature of the trustees of the Port Arthur Townsite Co. In fact, all deeds for this right of way are worded alike and give the Government the right to protect the banks of said channel. It is therefore clear in my mind that at the time of the construction of the canal it was considered feasible that this bank would have to be protected.

* * * * * * *

A survey will show moreover that the Sabine-Neches Canal now occupies a small strip of land that has not been deeded to the Government because in front of the city the dredges kept pretty close to the line described in the deed for the canal right of way and the few feet that were left between said line and the canal bank are all caved in and disappeared, and a survey will show that a narrow strip is now occupied by the Sabine-Neches Canal to which the United States Government has no deed.

* * * * * * *

In view of the fact that this strip of land has been donated to the United States Government and represents an enormous value, I think it only fair that the United States Government will see that no more land is used and lost than is strictly necessary and if it requires an expenditure of money to build the revetment it ought to be done for justice sake.

From letter of Mr. G. N. Bliss, agent, marine department, Gulf Refining Co.:

The building of this revetment would benefit navigation only to the extent of the amount of soil this revetment would prevent from finding its way into the canal, thereby lessening the cost of maintenance of the canal to some slight extent.

The Sabine-Neches Canal runs through the park system of the city of Port Arthur for an approximate distance of 2 miles. The right of way for this canal through the city limits of Port Arthur was donated to the Government by the Port Arthur interests—the consideration in the deed of transfer being $1 and other considerations. At the time this right of way was donated it was presumed that city and private property would be protected from damage during and after the construction of the canal. If I am reliably informed there is already considerable loss to city and private property abutting on the canal, due to the banks of canal caving in—if this is true it does not seem unreasonable for the citizens of Port Arthur to ask the Government for relief from further damage.

From letter of Port Arthur Light & Power Co., by Mr. Walter N. Munroe, superintendent:

Aside from the use of this plot of ground for power station purposes we have leased the canal frontage to various fish companies. They are operating numerous fishing boats in the Gulf, making their landing for discharging their fish on this piece of property, and have erected warehouses for the storage of fish until shipped to market. We have a chute for the delivery of ice to the water's edge and boats in general come here for ice, and a special line of boats operating between this point and the docks furnish ice to the large ocean-going steamers, this being the only spot on the canal at which ice may be conveniently taken aboard. The continual erosion of this bank will make it more and more difficult to handle the above business.

11. After the date of this hearing the hurricane of August 16–18, 1915, passed over Port Arthur and vicinity. The water rose to 6.9 feet above mean low Gulf level, flooding the city and adjacent low lands for many square miles in area. Owing to the continuance of southerly winds and high water in the Sabine and Neches Rivers due to the very heavy rainfall accompanying the storm, the water continued high for nearly two weeks, a considerable portion of the city being under water for that length of time. On September 16,

1915, in compliance with a request from the president of the Port Arthur Board of Trade, in which it was stated that the local interests had additional matter to present, a supplemental hearing was held at Port Arthur, extracts from the stenographic report of which are appended hereto.[1]

12. At that hearing it was stated that the city had decided, as a result of the recent storm, that it would be necessary to construct a levee entirely surrounding the town; that this levee along the canal would have to be placed quite close thereto at certain places on account of existing structures, and that the safety of the levee, even when located some distance back from the canal, would be endangered by the sloughing of the canal banks unless this were checked. No financial assistance was requested from the United States in the construction of the levee proper, but it was urged that the Government should cooperate in the work of protecting the city against future storms to the extent of revetting the canal bank to insure the safety of the levee. The following extracts from statements made at the supplemental hearing are believed to represent the present views and desires of the community:

From statement by Mr. R. H. Woodworth, president First National Bank of Port Arthur, Tex.:

> But the committee felt that in view of the fact that we were going to take hold of this matter in earnest, so far as the city was concerned, that if we could incorporate a scheme in connection with our intention to hold the flood waters out, with this revetment, it would work to the advantage of all interests. That is what we had in view. The committee has worked since the storm, and has retained a drainage engineer familiar with the Gulf coast section, who is working on plans, having in view incorporating a levee up and down the canal to the city limits of Port Arthur, with the proposed Government revetment if it was practicable and feasible.

From statement by Mr. Geo. M. Craig, president Merchants State Bank of Port Arthur, Tex.:

> If we could have any assurance that some protection would be given to that bank (the west bank of the canal) and it wasn't going to cave in, we could put the levee much closer than we would dare to now. * * * Now, they contemplated that they would have to protect that northerly bank. So I believe that if you are inclined to help us out in that matter, I don't believe there will be much opposition on the part of the Board of Engineers if they refer to the original deeds, and Gen. Mackenzie and Mr. Taft will no doubt remember that they wanted the right to come in and save that bank for us.

From statement by Mr. Jan Van Tyen, general manager Port Arthur Townsite Co.; general manager Port Arthur Land Co.:

> I understand that you believe that we would like to get the assistance of the Government in building the levee. I do not say that we wouldn't like to have assistance of course. But I believe the main reason for having this hearing asked for again is to tell you about the levee we are going to build, have to build to protect our land, and that might have a bearing on your report as to the advisability of the revetment. Now, if the revetment and the levee could be worked together, that would be, in our opinion, the ideal, but if that is not possible because the Government doesn't build levees, we certainly want you to bear in mind what we are going to build and then see if it would be necessary for the Government to build that revetment to protect the levee, and then ask the Government to build that revetment, only like we first asked.

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[1] Not printed.

From statement by Mr. G. N. Bliss, agent marine department, Gulf Refining Co.:

> I don't think it is the opinion of the committee that the Government should participate in the expense of these levees. I think the recent experience we have had shows what the conditions are liable to be, and the object of President Eubank in asking for the further hearing was to state to you the fact that it was necessary now for us to levee this town to prevent future floods, and impress upon you the necessity of a revetment along the canal bank through the city limits. Now, it is apparent that we have got to build levees, and it just depends on whether you are going to revet this side of the canal or not, as to where the location of the levees will come. If it isn't going to be revetted I don't know where we will place the levees. If you are going to wait for a fifteen-year storm you had better place the levee on the lake shore drive and abandon the drive. But it isn't the intention, and we are not asking the Government to participate in the levee expense at all. All we want to impress upon Maj. Barden at this hearing is that we would like to have the original idea of a revetment carried out, and by that means enable us to put our levees through our park system within a reasonable distance of the canal and know it would not cave into the canal within a short time.

13. The commerce of the Sabine-Neches Canal as reported to this office for the calendar year 1914 was as follows:

Articles.	Amount in customary units.	Amount in short tons.	Value.
Asphalt	90,138 barrels	15,774	$315,483
Cotton, baled	10 bales	3	500
Chickens	120 dozen	2	720
Eggs	16,200 dozen	12	3,240
Feed	26,000 pounds	13	260
Fresh water	4,288,896 gallons	17,799	1,716
Hides	750 hides	8	3,000
Ice	2,323,900 pounds	1,162	11,620
Logs	890 logs	534	2,225
Lumber	44,784,293 feet b. m	78,867	985,255
Machinery	6,000 pounds	3	600
Meats, dressed	784,722 pounds	392	78,472
Merchandise	961,106 pounds	482	36,150
Miscellaneous	488,000 pounds	244	7,420
Oils, crude	1,974,046 barrels	310,412	1,974,046
Oranges	80,000	12	800
Potatoes, Irish	4,550 bushels	136	4,550
Produce and truck	127,920 bushels	69	2,415
Sand	3,998 cubic yards	4,998	3,198
Shells, clam	4,365 cubic yards	4,365	5,465
Shells, oyster	244,032 cubic yards	244,032	170,822
Total		679,319	3,607,957

This commerce pertains largely to Orange and to Beaumont and other points on the Neches River. The greater part of that pertaining to Port Arthur, and all of the ocean-going commerce of the latter place, is handled at the docks on the Port Arthur Canal and turning basins below the city limits. The frontage along the canal within the city limits has been largely reserved for park and residential purposes.

14. The completion of the guard lock and the opening of the Sabine-Neches Canal to ocean-going vessels will largely increase the commerce of the canal, but none of this increase is expected to be handled along the Port Arthur city frontage.

15. The following table shows existing dockage facilities along the canal within the city limits:

No.	Ownership.	Area.	Frontage.	Physical connection with railroad.	Terms of usage.	Freight-handling facilities.	Designation.	Available depth.
		Sq. ft.	*Feet.*					*Feet.*
1	R. H. Woodworth.	144	12	None.....	Privately owned; not open to public use.	None.......	Wharf....	5
2	M. J. Naylor......	....	20	...do......	.....do........	.....do......	Landing..	5
3	Bowers Southern Dredging Co.	600	50	...do......	.....do........	.....do......	Wharf....	6
4	City of Port Arthur, Tex.	15,000	475	...do......	Free..........	.....do......	Slip.......	8
5	Texas Co.........	80	10	...do......	Privately owned; not open to public use.	.....do......	Wharf....	5
6	Port Arthur Pleasure Pier.	438,750	600	...do......	Free..........	.....do......	Pier.......	4
7	Texas Co.........	280	14	...do......	Privately owned; not open to public use.	.....do......	Wharf....	5
8	Asa Pevoto.......	196	14	...do......	.....do........	.....do......	...do......	6
9	Jno. R. Adams & Co.	144	12	...do......	.....do........	.....do......	...do......	5
10	Dave Berwick....	144	12	...do......	.....do........	.....do......	...do......	5
11	U. S. Engineer Department.	168	14	...do......	Not open to public use.	.....do......	...do......	6
12	.....do............	750	75	...do......	.....do........	.....do......	...do......	8
13	Ben Granger......	....	60	...do......	Privately owned,	.....do......	Landing..	6
14	Beaumont Fish & Oyster Co.	....	50	...do......	.....do........	.....do......	...do......	6
15	Sabine Ice & Towing Co.	720	60	...do......	Free to boats purchasing from owner.	Ice chute, ice factory to dock.	Wharf....	6
16	Texas Co.........	1,000	50	...do......	.....do........	None.........	...do......	6
17	U. S. Engineer Department.	....	100	Kansas City Southern Ry.	Not open to public use.	Hand derrick.	Landing..	8

16. The city of Port Arthur owns a frontage of 150 feet a short distance below Houston Avenue, and all the frontage from Houston Avenue to Vandervoort Avenue. It is thought that at the former locality a municipal dock and warehouse should be constructed for the purpose of handling package and miscellaneous freight to and from the city proper, mainly carried in light-draft boats.

17. No offer of local cooperation in the cost of the proposed revetment has been submitted.

18. From the nature of the improvement proposed there can be no question of water power involved. Its connection with the proposed levee for the protection of Port Arthur from floods is referred to in paragraphs 12 and 25.

19. The material through which the canal was dug is clay to within 2 to 5 feet of the surface. This clay stands up well, but the top soil, which is alluvial, gradually sloughs off when wet by tides and washed by the waves of passing vessels, leaving a wide berm at the top of the clay. The cross sections show the extent of this action.

20. Unless the bank is protected it is clear that the sloughing will continue—at what rate it is not practicable to predict—but such protection is clearly not necessary in the interests of commerce and navigation, as the amount of material carried into the canal is comparatively small, and its removal by dredging would be far cheaper than to construct the revetment.

21. This fact appears to be in effect recognized by the local interests, and it will be noted from the papers presented at the first hearing that the revetting of the bank by the Government was urged more as an appeal for protection from alleged injuries due to the construction of the canal than on account of any benefit that would accrue to navigation.

22. Stress was laid on the fact that the land for the construction of the canal was deeded to the United States free of cost, that the canal was dug close to the northern line of right of way so that due to sloughing the bank line is now outside the right of way, and that by implication from the wording of the deeds as well as because it was the duty of the United States to use no more land than was strictly necessary, the Government should now protect the bank without expense to the present riparian owners.

23. The weight of this appeal, however, appears to be weakened by the fact that the channel or canal as originally authorized by law (river and harbor acts of 1902 and 1904) was to be constructed through the lake, and that the change of location to a line through the land was made largely at the request of the Port Arthur interests, this change being authorized by the Secretary of War provided "that the right of way is furnished without expense to the United States," and also by the fact that the lake front in its natural condition was being eroded by wave action to a marked extent. This erosion was stated in a communication from the Port Arthur authorities dated August 31, 1905, as amounting to from 75 to 100 feet for the eight years prior to 1905, and on page 31 of House Document No. 549, Fifty-fifth Congress, second session (report on ship canal at Sabine Pass, Tex.), Mr. Robert Gillham, chief engineer of the Port Arthur Canal & Dock Co., states:

> The west shore of Sabine Lake has washed away an average width of 500 feet in the last 40 years.

It may therefore well be questioned whether the construction of the canal and the embankment on the lake side thereof has not, as a matter of fact, diminished rather than increased the natural caving of the bank, it being noted in this connection that this portion of the canal was located very close to the shore line and at one point entirely outside it. The value of the embankment as a protection against wave action was freely acknowledged at the supplemental hearing.

24. As to the reservation in the deeds for the right of way of the right to improve and protect the northwesterly bank of the canal, this was evidently a precautionary measure and should not be construed as carrying any obligation on the part of the Government to do so.

25. As to the new aspect of the case presented at the supplemental hearing, it may be stated that, while the determination of the city of Port Arthur to make the necessary expenditures to avoid, if possible, a repetition of the disaster which the city has just suffered merits admiration, the request for the construction of the revetment as a necessary protection to the proposed levee can not, it seems, be supported by any more convincing demonstration of its necessity from the standpoint of commerce and navigation than that previously

submitted. Where not forced by existing structures to be located close to the canal bank, the levee can be placed far enough back to give protection against sloughing of the bank at least for a considerable length of time. As indicated in paragraph 20, it would clearly be cheaper for the United States to remove by dredging any material that may wash into the canal even from the levee proper than to undertake the revetment of the banks.

26. In view of all of the above it appears that, while further caving of the bank may be expected if not revetted, such revetment, if undertaken, should be solely at the expense of the local interests since it is not necessary in the interests of commerce and navigation. I therefore report that in my opinion the locality is not regarded as worthy of improvement by the United States.

W. J. BARDEN,
Major, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., November 30, 1915.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded.

2. The change of location mentioned in paragraph 23 is stated to have been made largely at the request of the Port Arthur interests and was for their benefit. It seems fair to assume that when the Secretary of War authorized this change, provided "that the right of way is furnished without expense to the United States," he did not consider that due to the change the United States would be placed under any obligation to revet the north bank of the canal in front of Port Arthur if erosion should occur there. The right of way was furnished without any conditions on the part of the donors as to protection of their land, though the possibility of future erosion might have been foreseen. The reservation in the deeds of the right to improve and protect the northwesterly bank of said channel was evidently intended to provide against a possible erosion of large amount, which might endanger or make excessively costly the maintenance of the channel. It is a reservation and not an obligation. The erosion that has occurred has been very slow, and the expense of removing the material washed in has been small.

3. Regarding the request for the construction of a revetment as a protection to the proposed levee, it should be stated that the levee as planned is a small one, and its cost per linear foot is but a small fraction of what would be the cost of a revetment of any suitable type. There are few buildings in the immediate vicinity of the bank, and only one of these is of large value. The levee, however, is planned to pass inside of this building, since the latter is so constructed that a flood would not injure it.

4. The views of the district officer, that the locality is not regarded as worthy of improvement by the United States, are concurred in by me.

J. C. SANFORD,
Colonel, Corps of Engineers, Division Engineer.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
February 24, 1916.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. In connection with its consideration of this subject, the board gave a hearing at this office on February 23, 1916, a record of which is transmitted herewith.

2. The board is inclined to the opinion that some work of bank protection should be undertaken by the United States at those points within the city limits where it is necessary to prevent serious damage to abutting property. It therefore recommends a survey to determine the extent and advisability of the improvement and the additional amount of land required to accommodate the work.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member Present.

SURVEY OF SABINE-NECHES CANAL, TEX.

UNITED STATES ENGINEER OFFICE,
Dallas, Tex., April 10, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army.
(Through the Division Engineer.)
Subject: Survey of Sabine-Neches Canal, Tex., with a view to revetment in front of Port Arthur.

1. As directed by department letter of March 2, 1916, the following report of survey of Sabine-Neches Canal, Tex., with a view to revetting the north bank of the canal between Port Arthur, Tex., and Sabine Lake, such revetment work to be confined to the section of the bank within the city limits of Port Arthur, is submitted, together with plan[1] and estimate of cost of revetment and maintenance.

2. The city limits extend from about station 101 to about station 291 as shown on map accompanying the report on preliminary examination, a total distance of 19,000 feet. On March 8, 1916, the revetment committee of the Board of Trade of Port Arthur addressed the following letter to this office:

> We have just received a letter from our president, Mr. G. N. Bliss, who is at present in Washington, informing us that the Board of Engineers has reversed its decision in regard to the revetment of the Sabine-Neches Canal, and that the matter has been referred to you for further investigation and report.
>
> It is our earnest desire to cooperate with you in every possible manner in this matter; hence this letter.
>
> At a meeting of our committee yesterday afternoon—which committee has the matter in charge—it was decided that in view of the fact that the Government is endeavoring to reduce its appropriations this year, Port Arthur would be glad to modify its former request that the canal bank be revetted from the southwesterly city limits to the northeasterly city limits, so that it will now only cover a revetment extending from the Heisig & Norvell property—which is about 7,500 feet northeast of the southwesterly city limits—to the northeast boundary of the city limits.

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[1] Not printed.

While the property that we have thus excluded from our request has eroded some, the erosion has not been as great as it has farther up the canal. And again, erosion at this point does not imperil the homes of any of our citizens, the hospital or the high school, as it does elsewhere along the canal.

We feel confident that such additional right of way as may be necessary will be readily donated to the Government by the Port Arthur interests.

We repeat that we are desirous of cooperating with you in every possible manner, and sincerely hope that you will grant us the privilege of so doing.

In accordance therewith this report only considers the frontage from about station 178+00 to about station 291+10, as shown on the accompanying map,[1] a distance of approximately 11,300 feet. Of this frontage, the city owns all between Houston Avenue and Vandervoort Street, station 180+40 to station 285+20, or 10,480 feet, that above and below these points being privately owned.

3. The field work of the survey consisted of the determination of cross sections of the west (north) bank of the canal at about 500-foot intervals. These are shown on the accompanying drawing.[1]

4. Three types of wood revetment have been considered:

Type A is that shown on the accompanying drawing.[1]

Type B is identical with type A with the omission of the anchor piles.

Type C consists of a single row of Wakefield sheet piling constructed from three pieces of 3 by 12 inch material with waling strips.

All wood should be heavily creosoted. The estimated cost is as follows:

11,300 feet of type A, at $12 per foot	$135,600
11,300 feet of type B, at $10 per foot	113,000
11,300 feet of type C, at $12 per foot	135,600

5. It is believed that the reinforced concrete sheet pile type proposed below, though somewhat more expensive in first cost, would be the most satisfactory, and in the long run the most economical. Protection by grading the bank and paving with stone or concrete would be ineffective unless the paving were founded on some form of toe wall, the cost of which would largely offset the saving over the pile type of revetment.

6. The protection proposed consists of a row of reinforced concrete tongue and grooved sheet piles driven to elevation —10 feet, capped with a continuous reinforced concrete beam, and anchored back at intervals of 15 to 20 feet by 1-inch steel rods embedded in concrete, to reinforced concrete deadmen placed 25 feet back of the line of the revetment.

7. The revetment should follow the present bank line as closely as possible consistent with securing a good alignment. It is proposed to make it in general parallel with the center line of the canal and to place it at approximately the distances therefrom shown on the plan.[1] This places it inside and outside the present bank line for approximately equal distances. The material outside should be used for filling behind the revetment at points where it is outside the bank line.

8. The estimate of cost is as follows:

Concrete sheet piles, 165,650 square feet, at 70 cents	$115,955
Concrete cap (710 cubic yards concrete, at $12, $8,520; 177,000 pounds reinforcing rods, at 4½ cents, $7,965), 11,310 linear feet reinforced concrete cap, at approximately $1.46 per linear foot	16,485
689 anchors (496 cubic yards concrete, at $8, $3,968; 89,000 pounds steel, at 6 cents, $5,340)	9,308

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[1] Not printed.

Excavation for 689 anchors, 7,000 cubic yards, at 50 cents	$3,500
Fill behind concrete sheet piles, 7,500 cubic yards, at 60 cents	4,500
Contingencies, approximately 10 per cent	15,252
Total	165,000

9. No accurate estimate can be made of the cost of maintenance. Annual repairs will probably not be required. Two per cent per annum of the original cost would probably suffice for repairs and renewals when required.

10. This estimate is based on the assumption that the cost of revetting the city slip and of making necessary provisions for taking care of sewers and drains entering the canal along the line of the proposed revetment will be borne by the city or other local interests and that the additional right of way required will be donated free of cost to the United States, as indicated in the letter quoted in paragraph 2 above. The accompanying plans[1] show that the caving of the bank has extended beyond the land originally furnished. The additional right of way will be a strip 25 feet wide back of the line of revetment. Deeds in fee simple are not considered essential, a perpetual easement giving free access for the purpose of construction, maintenance, and repair of the revetment and anchorage being sufficient.

11. The work, if undertaken, should be prosecuted at such rate as to be completed in one year, and the initial appropriation should be the full amount of the estimate.

12. Since the date of the preliminary examination the canal has been opened to ocean-going vessels, and a number of such have passed up and down the canal in front of the city of Port Arthur. As anticipated, however, the wash from these is no more serious than from light-draft vessels. The city has completed its plans for levee construction, and bids therefor will be opened on April 12, 1916. It is understood that the outer toe of this levee will be placed 25 feet from the line of the proposed revetment.

13. My views as to the merits of this case were given in paragraphs 20–26 of the report on the preliminary examination. Other than mentioned in the preceding paragraph, the survey has developed no new facts or conditions pertinent to a consideration of this case. In connection, however, with the references made in the letter above quoted, and at the hearing before the Board of Engineers for Rivers and Harbors, to the possible danger to public buildings from continued erosion, attention is invited to the accompanying map (case 1/72), on which are shown the only two public buildings near the canal. The high-school building is 120 feet from the bank, which at this point is a portion of the original lake front, and has not eroded since the construction of the canal. The main building of the Mary Gates Hospital is 160 feet from the canal bank and the nearest outbuilding over 60 feet.

14. It also seems proper to call attention to the fact that should the frontage now requested be revetted there would be no logical grounds for later refusing equal treatment not only to the remaining portion of the city limits but also to the canal frontage above and below those limits. As such lands increase in value their claim to consideration would apparently come to be on a substantial parity with the portion for which revetment is now requested.

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[1] Not printed.

15. I must, therefore, again report that while further caving of the bank may be expected if not revetted, the indirect public benefits arising from such revetment appear to have too remote a bearing upon navigation facilities furnished by the Government to warrant its prosecution with river and harbor funds, and that in my opinion, therefore, it is not advisable for the United States to undertake any portion of the desired revetment of the north bank of the Sabine-Neches Canal within the city limits of Port Arthur, Tex., in the interests of general commerce and navigation.

W. J. Barden,
Major, Corps of Engineers.

[First indorsement.]

Office of Division Engineer, Gulf Division,
New Orleans, La., May 19, 1916.

The Chief of Engineers, United States Army:

1. Forwarded.

2. The plan of the revetment which the district officer considers preferable, and the total estimated cost of which he places at $165,000, appears to me unnecessarily elaborate and expensive, considering the local conditions and the purposes to be fulfilled.

3. As stated in the preliminary examination report, the erosion complained of is that of the alluvial top soil. This soil rests on clay which extends to below the canal bottom. The height of the top of the bank is from 3 feet to 6 feet above mean low Gulf level, and the top of the clay layer is from 2 to 5 feet below the top of the bank. Due to wave wash, the alluvial layer has cut back, as has also the clay above about the low water level. Below that point, however, there has been almost no erosion of the clay, the result being that there is now a wide clay berm or shelf outside the bank line, wherever the latter line has been washed back. From a personal examination of the conditions, and from such data as could then be obtained, I am of the opinion that the rate of erosion of the top bank is diminishing, and that a reasonable protection of the upper bank against wave wash is all that is necessary to prevent further injury, at least for a very long period. For this reason I requested the district officer to prepare an estimate for a revetment consisting of riprap covered with concrete grout and resting on a loose rock toe laid in a trench dug in the clay, the revetment to have a slope of 1 on 2; minor irregularities in the present bank line were to be straightened, but no attempt made to maintain the line of the revetment at a uniform distance from the center line of the canal. His estimated cost of this construction is as follows:

Stone for 2 by 3 inch toe, 3,325.14 tons, at $3.25	$10, 806. 71
Stone for paving, 5,456.05 tons, at $3.75	20, 460. 19
Concrete paving, 1,237.2 cubic yards, at $10	12, 372. 00
Excavation for toe, 3,770 cubic yards, at $1	3, 770. 00
Excavation for paving, 3,691 cubic yards, at 50 cents	1, 845. 50
Engineering and contingencies, approximately 15 per cent	7, 745. 60
Total	57, 000. 00

This estimate appears to be a fair one.

4. The survey has brought out no new facts in favor of the work being undertaken by the United States. The accompanying map[1]

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[1] Not printed.

gives the least distance from the edge of the bank to the high-school building as 120 feet, but the bank at this point is part of the original lake shore line and has not eroded. The Mary Gates Hospital is about 160 feet back from the bank, and the nearest outbuilding of this hospital, which, however, is of small value as compared with the cost of the revetment, is about 65 feet from the bank.

5. I am reliably informed that a contract has been let by the local authorities for the construction of the levee mentioned in the preliminary examination report; that the line of the levee is not to be a straight one, but is to follow approximately the present shore line, the outer toe of the levee being from 35 to 45 feet from the bank; that the top of the levee is to have an elevation, after settlement, of 9 feet above mean low Gulf level, which will make its height above ground surface from 3 to 6 feet, according to the elevation of that surface at different points; and that the total cost of that portion of the levee in the rear of the bank which it is desired to have revetted will be approximately $10,000.

6. The cost of the revetment, even if built on the less expensive plan which I have described above, appears to me larger than the benefits to be derived therefrom would justify. Moreover, the benefit to navigation would be very small as compared with the cost. If, however, it should be decided that the United States ought to revet this bank, it is recommended that the method of revetment by riprap be used, instead of any of the more expensive methods mentioned in the survey report.

J. C. Sanford,
Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors on survey see p. 3.]

Hearing Before the Board of Engineers for Rivers and Harbors. In Reference to Beaumont Harbor, Tex., Port Arthur Ship Canal, Tex., Sabine-Neches River, Tex., Lake Charlotte, Tex., Taylors Bayou, Tex. (Act of 1915).

February 23, 1916.

Col. Abbot, Col. Taylor, Col. Winslow, Col. Biddle, Col. Newcomer, and Col. Flagler were present.

Senator Morris Sheppard, Mr. G. N. Bliss, and Mr. Walter Gresham appeared before the board in reference to the above subjects.

Senator Sheppard. Gentlemen of the board, the first subject to be taken up is that of Beaumont Harbor.

Col. Newcomer. Mr. Wade came up and submitted data which bears on the matter of Beaumont Harbor. He submitted matters relating to certain conditions that have resulted from the storm. The district officer's report was made before the storm, and he suggests that the matter be held in abeyance for a time to await developments.

Senator Sheppard. Very well. As I understand it there are three matters in which Port Arthur is interested, the proposed Taylors Bayou project, the Port Arthur Canal project, and the Sabine-Neches project. I wish to introduce Mr. Bliss, of Port Arthur, who will speak to you in reference to those matters.

STATEMENT OF MR. G. N. BLISS.

Mr. Bliss. The maintenance of Taylors Bayou. Do you want to discuss that first?

Col. Newcomer. That is the first on the list.

Mr. BLISS. You have blue prints that will show that, have you not?

Col. NEWCOMER. Yes; we have them right here.

Mr. BLISS. Previous to 1910, the Gulf Refining Co. and the Texas Co. were located on what is known as the island. The property was acquired under lease from the Kansas City Southern Railway. The business of the two companies became so great that the traffic could not be taken care of at that point, and as the Texas Co. had the larger part of the island under lease, the Gulf Refining Co. decided to seek for a new location; in fact, they were compelled to do so. And in doing so they got a permit to deepen Taylors Bayou and establish terminals on property owned by themselves where the refinery is located.

After the permit was secured they built a canal from the Government turning basin to the location of their present docks, at which point they built a turning basin. The Gulf Refining Co. spent $230,000 on this construction.

In building this canal from the Government turning basin to where the wharves are now located, the Gulf Refining Co. dredged through what was outlined at that time as the proposed extension of the Government turning basin. They dredged a channel through that 1,700 feet and rounded off a point probably 300 feet more, 100 feet wide, and 26 feet deep.

The business done by the Gulf Refining Co. in 1914 from their wharves was 1,747,000 tons, valued at $19,000,000. In 1915 the business done from the Gulf Refining Co.'s wharf was 2,000,000 tons, with a value of $23,525,000. A great deal of that busines is coastwise, moved in vessels of the Gulf Refining Co.

The foreign business, moved in vessels not owned or chartered by the Gulf Refining Co. for the period of 1914, was 741,000 tons, with a value of over $7,000,000. That freight was moved in vessels not owned or controlled in any way by the Gulf Refining Co. They were chartered vessels from foreign concerns, which had come to pick up their cargoes.

I also wish to state that vessels of the United States Government call there regularly for fuel, the Gulf Refining Co. having the fuel contract for this year. They are vessels that draw, fully loaded, 26 feet of water.

The land abutting the canal dredged by the Gulf Refining Co. has a more general ownership than any land in that vicinity. Down at the old turning basin, where the Kansas City Southern terminals are located, and the Texas Co. terminals, the land surrounding those terminals is owned by the Kansas City Southern Railway, the old Port Arthur Canal & Lock Co.

When we dredged through property in dredging the canal from the Government turning basin, where the Gulf Refining Co. docks are located now, we dredged through property owned by the Port Arthur Canal & Lock Co., W. P. H. McFadden, J. M. Guffey Petroleum Co., Sun Co., John Harvey, A. G. Hutton, Port Arthur Land Co., Southern Pacific Railway Co., Kansas City Southern Railway Co., and Port Arthur Rice Milling Co.

I mention that to show that there is a more general ownership of land in that vicinity than there is anywhere else on deep water at Port Arthur, or around deep water.

Col. NEWCOMER. This map shows much the greater part of the land adjacent to that canal leading to the turning basin owned by the T. & N. O. Railway Co.

Mr. BLISS. That is the Southern Pacific.

Col. NEWCOMER. I say, very much, or the greater part of it belongs to them. There may be any number of other owners, but they own very small tracts, apparently.

Mr. BLISS. That is west of the Southern Pacific Railway.

Col. NEWCOMER. There is very little land abutting on the canal which is owned by anyone else except that railroad?

Mr. BLISS. There are tracts down here [indicating on map].

Col. NEWCOMER. The Gulf Refining Co. and the Sun Co., but they are practically on the turning basin?

Mr. BLISS. Yes.

Col. BIDDLE. Where is what you call the island?

Mr. BLISS. It is the land where we were located [indicating on map]. Taylors Bayou was to run around this way [indicating]; in fact, it does, anyway. We made this cut-off [indicating] before we dredged this canal through here [indicating on map].

Col. NEWCOMER. Apparently, all the land on that channel and turning basin, when you get beyond the new turning basin which the Government maintains, is owned by either the railroad or your company?

Mr. BLISS. Well, no. The Laughlin Co. own this [indicating on map].

Col. NEWCOMER. There on the other side?

Mr. **Bliss.** It runs down to the bayou.

Col. **Newcomer.** But it is beyond the limits of this work?

Mr. **Bliss.** Yes, sir.

Col. **Newcomer.** That is what I mean; I mean abutting on this improvement.

Mr. **Bliss.** It all belongs to the Gulf Refining Co., the Kansas City Southern Railway, and the Southern Pacific Railway, with the exception of those small tracts down here [indicating on map].

Col. **Winslow.** Are there any docks on that part, except your own?

Mr. **Bliss.** None to amount to anything. There are two marine railways and a very extensive shipbuilding plant being talked of now, and I think it is quite sure to go in on that island owned by the T. & N. O.

Col. **Flagler.** That is the island you made by the cut-off.

Mr. **Bliss.** Yes, sir. There is a shell-delivery plant up there, also, and there is a good deal of traffic that goes up Taylors Bayou. It is all light-draft traffic. If the intercoastal project goes through, that portion of Taylors Bayou will be part of the intercoastal canal.

Col. **Abbot.** You mean by that the cut-off or the old part of the bayou?

Mr. **Bliss.** The new cut-off.

Col. **Newcomer.** That is still undetermined, is it not, in some places?

Mr. **Bliss.** Yes; I understand so.

Col. **Newcomer.** They may go down near Sabine——

Mr. **Bliss.** I understand so.

Col. **Newcomer.** The route recommended hitherto was through a bayou, but there is a consideration of a relocation of it on account of certain difficulties.

Mr. **Bliss.** I did not know they were considering a relocation of it.

In regard to this matter I want to state, which I presume is unnecessary, that the maintenance of this canal and turning basin that the Gulf Refining Co. are asking for——

Col. **Biddle.** How long has that canal been dug?

Mr. **Bliss.** It was dug in 1910.

Col. **Biddle.** And have you maintained it pretty constantly ever since?

Mr. **Bliss.** There has not been a dollar's worth of maintenance on it up to the present time.

Col. **Biddle.** What is the depth now?

Mr. **Bliss.** We are moving ships out of there drawing 26 feet; but it is shoaling on the west bank.

Col. **Biddle.** Narrowing up?

Mr. **Bliss.** Yes, sir; and the dredge *Sabine*, it seems to me, could take care of that maintenance very nicely without any additional cost. There is money appropriated for the maintenance of the dredge *Sabine* for a year, and it would be a small matter for them to go in and maintain that waterway, as I regard it, and particularly in view of the fact that we had to move away from the lower location, where the Government maintains a turning basin and a large turning basin where the Texas Co.'s terminals are located and the Kansas City Southern terminals are located. When it was decided to dredge this canal the Gulf Refining Co. were put to a great deal of expense in moving their pipe lines, which was necessary for them to do for the reason that there was not room enough to handle the business where they were located, and one or the other had to move, and we were the ones that moved.

Col. **Newcomer.** It is my impression that the estimated cost of the maintenance runs from about $5,000 to $7,000 a year.

Mr. **Bliss.** Yes; I do not think it would exceed that if it was kept up continually; and there it not much work for the dredge in the wintertime, is there, Col. Taylor?

Col. **Taylor.** I do not know how it is going to be when we get the canal finished and get settled down. I think it probably would not take all of our time; but, of course, the appropriation for the maintenance of the Port Arthur ship canal is not for the operation of the dredge for a year.

Mr. **Bliss.** The business out of Port Arthur Canal, or I would say a third of it, starts from the Gulf Refining Co. wharf either in bottoms owned by them or vessels that come there to pick up cargo. The citizens of Port Arthur feel that the Gulf Refining Co. deserves at least the assistance of the maintenance of the waterway, and they have requested me, as president of the board of trade, to come up and take these matters up. But they are so well known to Col. Taylor and possibly some of the other members of the board that I do not think there is anything more that I can say. I should be very glad to answer any questions that the board may have to ask.

Col. ABBOT. Your position is that inasmuch as you have advanced about $200,000 to provide for a waterway which can be used by others as well as by yourselves——

Mr. BLISS. And is being used to-day——

Col. ABBOT (continuing). That you think it would not be a great stretch of generosity on the part of the United States to maintain the depth that you have requested?

Mr. BLISS. That is the feeling I have.

Col. ABBOT. That is your position?

Mr. BLISS. Yes, sir.

Senator SHEPPARD. I desire to say that I indorse that position that Mr. Bliss takes, and I wish to emphasize it as far as I can and ask the board to consider it.

Mr. BLISS. I have here some data which I would be pleased to leave with the board, showing the number of ships that called at the Gulf Refining Co. wharf during the year 1914. It gives the draft and the size of the vessels, the tonnage and destination. It gives the foreign business and the coastwise business.

I have a blue print here that I do not know whether you have or not. It is larger than your map, and it shows you the whole country there.

Col. ABBOT. We are very glad to have it.

Col. NEWCOMER. I desire to ask Mr. Bliss if this locality has any other dredging plant besides his own company?

Mr. BLISS. No, sir; there is not. At Galveston they have a dredging plant.

Col. NEWCOMER. Would an arrangement whereby the Government plant would be utilized and the expense of operation be paid by the oil company meet their views?

Mr. BLISS. Well, it would meet their views—if you would not consider maintaining it, of course by that means, I presume, they would be able to get cheaper work done.

Col. NEWCOMER. I did not know whether, in case there was no local plant, it would permit the Government plant to be used.

Col. TAYLOR. When no private plants can be obtained—we do not like to do it if there is any possible chance of getting private plants.

Mr. BLISS. There are plants in that vicinity that could be obtained.

Col. BIDDLE. Is commerce being hampered by the shoaling?

Mr. BLISS. Yes, sir; you see the sediment there is a very soft silt, and while ships come in there at 26 feet they are really plowing through a foot or 18 inches of silt.

I think the engineers ought to take into consideration the fact that at the time the Gulf Refining Co. dredged that canal, they dredged a channel through the proposed turning basin 1,700 feet long—yes, 2,100 feet long, 100 feet wide, and 26 feet deep. Immediately after that dredging was done the Government came along and dredged that turning basin, and it saved them a large amount of dredging right there.

Col. BIDDLE. How wide is that?

Mr. BLISS. Six hundred feet by 2,700 feet long.

Col. ABBOT. Your work was in cooperation with the Government in the creation of the existing new turning basin?

Mr. BLISS. Yes, sir.

Col. BIDDLE. About one-sixth of it?

Mr. BLISS. Yes, sir.

Col. BIDDLE. The next subject is the opening of the Port Arthur Canal.

Senator SHEPPARD. I would like to make this statement in connection with Mr. Bliss's very forceful argument. The business of this company would have been quite an argument for the extension of this harbor at the expense of the Government in the first instance. If I had introduced a bill to extend the harbor, the business of this company would have been one of the principal arguments that I could have advanced. It seems to me that the company is quite modest in its request.

Col. ABBOT. The next question is the Port Arthur Canal; that is, the opening between the lake and the canal.

Mr. BLISS. Would you mind taking up the subject of the revetment of the Sabine-Neches Canal first?

Col. ABBOT. If it is more convenient to you, we have not the slightest objection.

THE SABINE-NECHES CANAL.

Mr. **Bliss**. This canal was dredged through the park system of the city of Port Arthur for a distance of 2 miles. The right of way was donated to the Government by the city of Port Arthur, the consideration in the deed being $1, and other considerations. The citizens of Port Arthur naturally thought that the other considerations would naturally mean the maintenance of the canal through the park system.

Before the canal was dredged, a great many public buildings—a great many for us, but very few for you people here—there were several public buildings located close to the canal, which are now in danger from the continual erosion of the canal banks. In spots through the city limits the canal banks have wasted for a distance of 10 to 30 or 40 feet; in fact, the canal banks have wasted now beyond the right of way donated to the Government, where it has taken away city property and private property.

At the time the canal was dredged, sewer lines were run to the lake. When the canal was dredged through, these sewer lines were cut only to reach the edge of the canal. To-day in places these sewer lines are out in the canal 20 or 30 feet above the city where the land is considerably higher. Shrubbery such as orange trees and things of that kind were planted up to the Government right of way, and they are now dropping off into the canal.

The city of Port Arthur has recently voted and issued and sold $180,000 worth of bonds to build a revetment in front of the city of Port Arthur to prevent a recurrence of the high water we had in August——

Col. **Newcomer**. You mean a levee?

Mr. **Bliss**. Yes, sir. In addition to this $180,000 worth of bonds voted by the city, the railroads and industrial plants, the Texas and Gulf Refining Cos., have authorized an expenditure of something like $750,000 to build levees around the back end of the town that will connect with the levees proposed to be built by the city of Port Arthur in front. These levees are for the purpose of keeping the water out of the town. During the storm in August I lived in rather a high part of the town and there was 18 inches of water in my house, and the losses during that storm will amount to more than it will cost to levee the town.

Our engineers who have had charge of this matter are up against this problem: If the canal is not to be confined, where are they going to locate their levees? The banks are washing and will continue to do so. Our engineers point out to us that we can not build this levee too close to the canal banks unless something is done, for the simple reason that the levees and everything else will go into the canal.

Col. **Abbot**. Is the washing of the canal banks due to commerce going through the canal, or is it storm washing?

Mr. **Bliss**. Due to commerce going through the canal. These light-draft vessels, particularly gasoline launches, make as much wash as a steamer there. They are continually going up and down.

I have some pictures which I would like to submit, if you care to have them.

Senator **Sheppard**. There are some large buildings there where the washing is very dangerous?

Mr. **Bliss**. The canal bank, from the hospital, is 40 feet.

Senator **Sheppard**. The levee would go between that building and the canal?

Mr. **Bliss**. I think that a very shallow retaining wall would hold that material back and stop the sloughing, inasmuch as this bench [indicating on map] has been formed.

Col. **Taylor**. There is a very marked bench in those places [indicating on map]?

Mr. **Bliss**. From Shreveport Avenue up to the turn of the Seventh Street Road is the worst.

Col. **Winslow**. That only goes in, according to the scale, about 25 feet.

Col. **Abbot**. If you had some reinforced concrete along there, would not that make a scour?

Col. **Taylor**. It seems to me it would be better to apply some loose one-man stone.

Mr. **Bliss**. Would not that have a tendence to slough off and go down into the canal?

Col. **Taylor**. It looks as though that bench was marked enough so that they would hold.

Mr. **Bliss**. It might be at places, but I doubt if that is so all along. It seems to me that we could go down there 4 or 5 feet in that clay and it would hold, and that is all the people are asking, in the world—just to confine the canal there in some way. Would it not be possible just to cofferdam that water up and put some reinforced concrete there?

Col. **Taylor**. I do not think you would have to cofferdam it at all.

Mr. **Bliss**. We have high tides there, particularly in the summer and spring, and they just saturate that top earth and it sloughs off and drops in.

From the navigation standpoint there is not much to be said, further than that the one direct saving to navigation would be in the amount of earth that sloughs off and finds its way into the channel and has to be dredged out.

All that the citizens of Port Arthur ask in the world is that the Government confine the canal so that we can go ahead and have some assurance.

Col. **Abbot**. You mean keep the canal inside of our own right of way?

Mr. **Bliss**. That is it. It is outside of your right of way in many points. What we want is that you shall confine that right of way and let it be known that you are going to confine it, so that we can go ahead with our work. We are very anxious to get a levee around the city of Port Arthur before next September, and our engineers state that they are unable to locate where that levee will go down in the park section until they know that absolutely.

Col. **Taylor**. Do you not think that is a matter that ought to be handled by the city of Port Arthur, that revetment there?

Mr. **Bliss**. No, sir; to be frank with you, I do not. I think that it is one that is entirely up to the Government, for the simple reason that if you and I dredge a canal through a person's piece of land, I think we would be looked to to protect the land through which it passes.

Col. **Taylor**. The laws are different relating to private individuals from what they are relating to the Government.

Mr. **Bliss**. That is true; but I do not see why it should be so in this case. The proposed right of way is out in the middle of Lake Sabine, and the proper place to bring it is inside. We gave you the entire right of way for 7 miles. It did not cost the Government or anybody else a cent, and it looks to me now that, through the city limits, where it is very manifest that the citizens are suffering, the Government should make some effort to confine that canal. If it is necessary, I will guarantee to give you deeds to the lands that are washed away now. You can extend your canal bank out 10 feet or 20 feet. We can secure these deeds for you and we will be glad to do it. All we want is to know where the end is going to be. What we want to know is whether it is going to continue to wash, and if it is, where are we going to have our levee? We have practically a million dollars available now for protecting the city of Port Arthur, and we can not go ahead and expend that money intelligently until we know something is going to be done with the canal frontage.

I will just refer, now, to the opening of Sabine Lake.

We have always considered that we were entitled to an opening into Sabine Lake. We are willing to forego that opening into Sabine Lake, and we will just abandon that if we can have this other thing. We can go out to-day to the pleasure pier and enjoy to a certain extent the privileges of Sabine Lake that we used to enjoy before the canal was through, and we are willing to just drop that opening into Sabine Lake——

Col. **Winslow**. You do not mean to imply that the canal is more of a damage to Port Arthur than a good; that you would rather have the canal closed up?

Mr. **Bliss**. Oh, no, indeed. But it has deprived us of the use of Lake Sabine, and it has made a very unsightly appearance of our city front where we used to get a clean, unobstructed view.

Col. **Abbot**. This particular section here [indicating on map] is not as useful to you as this part of it?

Mr. **Bliss**. No, sir. As far as the Gulf Refining Co. is concerned, we do not use that part of the canal at all.

Col. **Newcomer**. Your company is not going to operate in the part above?

Mr. **Bliss**. No, sir.

Col. **Newcomer**. There is one little company going up there?

Mr. **Bliss**. Yes, sir; there are one or two oil companies that will use the canal and the Neches River to Sabine and Orange.

Col. **Biddle**. You said that the canal cut off the view of this lake. Will not the levee do the same thing?

Mr. **Bliss**. The levees will not be as high. I was going to say that we had a very clean lake front before this canal was dredged. Now, the rushes are growing up in front of the town, and it makes it very undesirable.

Col. Newcomer. Your land in front was washing away more rapidly before than since the canal was built, because then your shore was exposed to the storms?

Mr. **Bliss.** Yes, sir.

Col. **Newcomer.** Now you are protecting it to some extent?

Mr. **Bliss.** Yes, sir.

Col. **Newcomer.** The canal came in here at the invitation of the locality, and one of the conditions imposed was that there should be a free right of way?

Mr. **Bliss.** Yes, sir; which the city gave.

Col. **Newcomer.** Should not that free right of way include this kind of protection?

Mr. **Bliss.** I do not think so. It is a very small expenditure, and we would not have had a word to say in the world if it had stayed within the right of way granted, but it has washed outside of that. All that we are asking in the world is that the canal be confined.

Col. **Newcomer.** It does not seem to slough on the lake side of the canal so much?

Mr. **Bliss.** Oh, it does. I do not think there is very much difference, is there, Colonel?

Col. **Taylor.** There is a little place in there that has been dredged so that it has not had a chance.

Mr. **Bliss.** If you gentlemen will recommend some way of confining that canal, we are perfectly willing to drop the opening into Sabine Lake, and under the circumstances it seems reasonable to us that you should do so. The city of Port Arthur had her terminals located before this Sabine-Neches Canal was dredged. As a matter of fact, up to the present time there has not been a move contemplated whereby any Port Arthur interest will use the Sabine-Neches Canal. The land is all owned on one side by the Government and on the other side by the Port Arthur Canal & Lock Co. Then you strike city property, and above the city is residential property that the Port Arthur people hope never to see used for any shipping purposes. They want to confine their shipping all down at the lower end.

Col. **Newcomer.** Are there any deep-draft boats going up now to Beaumont?

Mr. **Bliss.** Yes, sir; they are commencing to go. Several have gone to Orange and one or two to Beaumont. They seem to be taking advantage of it.

Senator **Sheppard.** Permit me to state right there that the Secretary of the Treasury has located a customs station at Orange and also a station at Beaumont, in view of the development since the canal was completed to both those cities.

I want to ask Mr. Bliss, in this connection, what especial value has the Sabine-Neches Canal to Port Arthur?

Mr. **Bliss.** None; except that it forms a link in the intercoastal canal.

Senator **Sheppard.** What prompted the citizens of Port Arthur to request that the canal be constructed through land in front of the city and on the side of the lake, rather than through the lake?

Mr. **Bliss.** It was brought up by interested parties of Beaumont and Orange who were trying to get deep water into Beaumont and Orange.

Senator **Sheppard.** Did they not do it as a matter of kindness to Beaumont and Orange?

Mr. **Bliss.** Yes. The canal was first located in the middle of Sabine Lake. They realized that it would be a hard proposition to maintain, and came down to the north end, where we would give them a right of way. The hardest proposition was putting a right of way through the park system, where the schools were located. I want to state further in this connection that we have recently voted school bonds for $560,000. A school, two units, under the Gerry system, will be built in that park property. Those bonds have been sold.

Col. **Abbot.** What chance is there that there will be need of revetting the canal banks not only within the limits of the city but where it goes farther up?

Mr. **Bliss.** As you go above the city limits I do not think you will have trouble.

Col. **Biddle.** How large a place is Port Arthur?

Mr. **Bliss.** We claim that we have 17,000 people. Port Arthur has quite a remarkable record in many things. Her tonnage includes this year, foreign and coastwise, 6,567,000 tons. That is a million-ton increase over last year. The total valuation is $89,000,000. That is $7,000,000 increase over last year. Vessels clearing from the port, 1,130 during the year.

Col. **Abbot.** About one vessel to every 15 inhabitants?

Mr. **Bliss**. Yes, sir. Our post office shows an increase; the customhouse shows an increase. We are right close to Galveston now—Mr. Gresham's town—in tonnage. They have a little the advantage of us on values. Their commodities are high-priced, and ours, unfortunately, are low.

I thank you gentlemen very much, and I hope you will give us favorable consideration on these matters.

Col. **Abbot**. You say you are willing to drop the connection between the canal and the lake?

Mr. **Bliss**. Yes, sir. If you care to have photographs of the front that have recently been taken, I shall be very glad to send them to you. I should have had them here this morning, but they were misplaced.

Col. **Abbot**. If you will mail them to us we will be very glad to have them in our files.

Mr. **Bliss**. I shall be very glad to do that promptly. They will give you an idea of just how conditions are down there. I will be pleased to attend to that right away.

Senator **Sheppard**. Before you leave this proposition, I wish to submit this question:

From a technical standpoint, is it not safer as a rule to run a canal of that kind along the side of a broad, shallow lake, rather than through the middle of the lake?

Col. **Abbot**. Unquestionably.

Col. **Newcomer**. That was really the project when it was changed to come inside; in other words, it was to go out of the limits of the lake, but right near the shore, with the expectation that the excavating material would protect the embankment on the other side.

Senator **Sheppard**. The point I wished to make was that it was really to the interest of the Government and of navigation to construct the canal where it is now, rather than through the lake.

Col. **Taylor**. Also to the interest of Beaumont and Orange, who paid one-half?

Senator **Sheppard**. Exactly; but especially due to the right of way——

Col. **Abbot**. That is the point I tried to bring out in one of my questions.

Col. **Taylor**. So it would be fair to ask Orange and Beaumont to pay for this revetment?

Senator **Sheppard**. That is another question. You have already assumed the maintenance of the canal as a Government project. That was carried in the last rivers and harbors bill.

Col. **Taylor**. That is, maintenance as far as the mouth of the Neches River?

Senator **Sheppard**. Yes, sir.

Col. **Abbot**. And your point is that the holding of the banks of the canal is maintenance of the canal, and that is particularly recommended as to this part of the canal passing through valuable land in the city of Port Arthur?

Sentor **Sheppard**. That is the point; and I wish also to make the further point that it is a general principle of law and equity that an individual or a government ought to so handle and manage its property as not to injure that of other people. The Government has control of that waterway for the purpose of navigation, and it certainly ought to so control it and handle it as not to permit injuries to others.

LAKE CHARLOTTE, TEX.

Col. **Abbot**. The next item is Lake Charlotte, Tex.

Senator **Sheppard**. A gentleman from Liberty, Tex., wrote in and asked for the privilege of having a hearing. He was notified that the hearing would be given and did not appear. I am perfectly willing to leave that proposition to your own judgment.

Col. **Abbot**. And the Guadalupe River?

Senator **Sheppard**. As to the Guadalupe River, I understand that Mr. C. S. E. Holland, of Victoria, Tex., has already presented arguments on that matter, so it will not be necessary to have a further hearing of that.

Col. **Newcomer**. As to Galveston, the board decided at its last meeting to request additional information from the district officers before it proceeded with the consideration of Galveston. Do you wish to talk about that item? It is before the board.

Senator **Sheppard**. Col. Gresham is here before the board. We wanted to have a survey made so that we could get a report before the Senate finally passes upon the rivers and harbors bill. We wanted to urge all possible speed in the matter. Has the data that you asked for been received?

Col. Newcomer. It has not been received yet.

Col. Abbot. The board passed upon the report to that extent at the last meeting, that the district officer did not give any data. They are asking for 35 feet, and he did not give any data as to several very necessary items, and the board thought it ought to have information on that question before passing on the report. So a letter was written to the district officer to get that information, and there has been no reply as yet.

Senator Sheppard. Did that apply to Port Bolivar also?

Col. Newcomer. No, sir. The board has not yet taken up that matter.

Senator Sheppard. I would like to have you hear what Mr. Gresham has to say.

STATEMENT OF MR. WALTER GRESHAM.

Mr. Gresham. I do not know that I have anything in particular to say, except to answer questions, should there be any.

I did not quite catch exactly what you stated in regard to the information you wanted. Was it about the number of vessels from Galveston?

Col. Abbot. Yes.

Mr. Gresham. You have recently asked for that?

Col. Abbot. We have asked that the district officer furnish that information. The pilots keep the records, of course, of all the drafts, because the pilotage dues are based upon the drafts of the boats.

Mr. Gresham. I do not believe you will get very much information there, because the ship agents, in getting vessels, always figure the draft that the harbor will admit coming in.

Col. Abbot. You have a 30-foot project?

Mr. Gresham. Yes, sir.

Col. Abbot. And you do not know whether they are using that to the limit or not?

Mr. Gresham. I think we are more than using it. I think Col. Riché had it in his report.

Col. Abbot. The statement he submitted was a statement from one of the shipping plants down there as to the relative economy of the deep-draft boat and the lighter-draft boat, but there was nothing as to the actual traffic drafts.

Mr. Gresham. It must have been lost in some way, because my recollection is that Mr. Morrow—I asked him to give that information, and my recollection is that he made out a tabulated statement. I may be mistaken in that, because there is so much of it that I do not remember it all.

Col. Abbot. It is quite possible that the district officer had that, but he did not transmit it.

Mr. Gresham. You wanted to know what the drafts of the vessels were coming in and going out from Galveston?

Col. Abbot. Going in and loading and unloading.

Mr. Gresham. As I said before, the tonnage is so scarce now that the chances are that no vessel was ever brought to the port that could not get out over a 30-foot project.

Col. Abbot. There is a statement made by the district officer with reference to the Texas City project upon which the board has requested the interested parties to be notified, that the 30-foot project to Texas City will accommodate the ocean vessels plying in the Gulf of Mexico; in other words, they appear to be perfectly satisfied with 30 feet as meeting their needs up to Texas City——

Mr. Gresham. That may be, that they would be perfectly satisfied with it, because their project right now is something else. What they are after is that turning basin, and they have got a project of 30 feet up to that point, and, of course, they are not going to talk about 35 feet now until they get that 30-foot project. They are not going to advocate it.

Col. Abbot. They claim, Col. Gresham, that the 30-foot project accommodates all the Gulf of Mexico traffic; in other words, that there are no boats for the deeper project at other points.

Mr. Gresham. I do not think that the evidence will bear that out.

Col. Abbot. That may be.

Senator Sheppard. You are investigating that point now?

Col. Abbot. Yes, sir.

Col. Taylor. These statements are inconsistent. One report says 30 feet is enough and another report calls for more than 30 feet in the same locality.

Mr. Gresham. The larger vessels that come in do not go to Texas City.

Col. **Winslow.** The same officer that makes the report—that is not the Texas City people that make the report; it is Col. Riché who says that.

Mr. **Gresham.** The 35 feet that we are after—I do not recall what Col. Riché said about the length of time it would take to get that 35 feet. My recollection, from talking to Col. Taylor and with the contract company, is that it would not take very long.

Col. **Newcomer.** You have 32 or 33 feet now?

Mr. **Gresham.** I think it is 33 feet. Col. Taylor knows better than I do.

Col. **Taylor.** I think it is 33 feet.

Col. **Biddle.** The last one they showed us was 32 or 33 feet.

Senator **Sheppard.** How long will you gentlemen be in session this time?

Col. **Abbot.** To-day and to-morrow.

Mr. **Gresham.** How long since that information was requested of Col. Riché?

Col. **Newcomer.** Two weeks ago it went back. It takes some little time to get through the department, you know, on account of being recorded, and all that sort of thing.

Col. **Taylor.** It would come in one day and go out the next.

Mr. **Gresham.** I have no doubt we can get that information; but what we are after particularly is this: We would like to have a survey ordered as soon as possible. Col. Riché, I know, has all the data to furnish to you in regard to what it would cost. All the data for that survey is in his possession.

Col. **Newcomer.** The law provides that a survey shall not be ordered unless it is justified and the improvements shall not be made unless they are necessary. The same thing was reported on here only a few weeks ago. They asked for 35 feet, and it was discussed at considerable length and decided that it was not advisable.

Mr. **Gresham.** One of the reasons was that we did not have cargoes enough. Of course, that has been eliminated, because we carried over 750,000,000 bushels of wheat. There are a great many ores; a great deal of zinc—last week. I saw in the paper yesterday that over 100,000 pounds was carried in one vessel last week. So it is constantly increasing, and unless we can have the 35 feet, ultimately that character of freight that is going there now is bound to go somewhere else.

I am going to be perfectly frank with you and tell you why we are anxious to have it. Col. Riché, in his report—if I misstate it, I hope you will correct me, because I want to get the facts—I understand that he proposed to deepen it simply by dredging it. We have the *Galveston* there, and it is estimated, I think, to operate the *Galveston* it will take about $100,000 a year. Col. Taylor can tell you about that.

Col. **Taylor.** $150,000 would be nearer.

Mr. **Gresham.** You appropriated so much for maintenance of the channel. If we can increase that in such a way as to get just a little bit more and permit the *Galveston* to dredge it down to 35 feet, it would cost so little more in maintaining it that they thought it might not be considered a new project by Congress. That is what I am after.

Col. **Winslow.** When it is through the bar there would be a lot more dredging inside.

Mr. **Gresham.** I understand; and if we could get that dredged through the bar, it would be much easier to get the dredging of the channel next time. Texas City is not asking for 35 feet; they are not ready for it; but we are trying to get ready for our part of it.

Col. **Newcomer.** Can you not get one port on Galveston Bay that would be open to the public without being in the hands of a corporation?

Mr. **Gresham.** I do not think they are in the hands of a corporation now.

Col. **Newcomer.** Each one of these particular points is in the hands of one—Texas City, Galveston——

Mr. **Gresham.** No, sir; Galveston is in the hands of four or five of them. The wharf company, the Santa Fe Co.——

Col. **Newcomer.** Does not the wharf company practically get a toll from everything that comes in there?

Mr. **Gresham.** No, sir.

Col. **Newcomer.** But I understand that everything entering Galveston Harbor has to pay something to those companies under their charter.

Col. **Taylor.** That is what we were told when we were down there—that even if a vessel transferred to a lighter out in the harbor——

Mr. **Gresham.** When the lighters come down and touch the wharves with a view of loading from the barge onto the vessel, they do charge.

Col. **Taylor.** Suppose they do not touch the wharf, would they have to pay then?

Mr. **Gresham.** No, sir; if they lay out in the stream they will not have to.

Col. **Newcomer.** We were told down there that that was one of the provisions of the charter——

Mr. **Gresham.** That is all talk, that part of it. I recollect that they raised that point in going from Galveston to Texas City. The question was raised as to a monopoly. The tolls of the Southern Pacific and the Santa Fe and the Rock Island will of themselves force the wharf company to come to the figures fixed by the city.

Col. **Newcomer.** Will you submit to the board, at your earliest convenience, a statement as to just what the rights of the wharf company are?

Mr. **Gresham.** Yes, sir. I would like to submit it to them to see if my statement is correct.

Col. **Newcomer.** Very good.

Col. **Winslow.** Has any move been made by the city of Galveston to control its entire water front?

Mr. **Gresham.** No, sir. With a population of forty-odd thousand people and a taxable value of $40,000,000, we can not pay out $5,000,000 for improvements in the wharves.

Col. **Newcomer.** It is a very lucrative business, is it not?

Mr. **Gresham.** I do not know. There is some dispute as to that. I do not know anything about it.

Col. **Newcomer.** The city could well afford to own it if it is a paying proposition.

Mr. **Gresham.** I do not think it has ever paid a dividend over 6 per cent.

Col. **Winslow.** Is that 6 per cent on a true valuation or a watered valuation?

Mr. **Gresham.** No, sir; I think it is 6 per cent on the money actually paid into the improvements.

Col. **Winslow.** They would issue stock instead of declaring dividends?

Mr. **Gresham.** Yes; putting all the earnings into the improvements, as I understand it. Consequently they would like to increase the stock and bonds, doubtless, now, but I think they are kept from it by the Railroad Commission of Texas, which will not permit them to do that. That is the trouble.

I think if the Southern Pacific and the Santa Fe make their improvement, if the present project for extending the sea wall goes through—of course they can not do it unless that is dug—but if we carry that through this time the Santa Fe will begin theirs, and I think you can readily see that the minute the city can control one, two, or three independent companies and fix their rates, the wharf company is bound to meet them. It can not do otherwise.

I recall when we built the Gulf, Colorado & Santa Fe Railroad parallel to the H. & T. C.—I believe I gave you this illustration before—when we built that for the first 4 or 5 miles parallel with the H. & T. C., the freight that was legitimately belonging to the Santa Fe road was turned right across our tracks and carried over the H. & T. C. It took from five to ten years to divert the traffic that legitimately belonged to them over to them. The H. & T. C. during that time was claiming that they had a special charter that gave them a special right to make those charges, but as soon as we got in position with our road to dispute the fact, they have come to us. Now they submit without a word. That will be the case at Galveston, as we think. You can not have a thing that is absolutely fixed by the company itself come in competition with something that is regulated by the Government. That is my view of it. Is there any question?

Senator **Sheppard.** I want to ask you a question. Has the channel been extended as far as it is authorized to be extended under the existing project?

Mr. **Gresham.** I do not know.

Senator **Sheppard.** I wish to ask the board that.

Col. **Taylor.** No; it has not.

Senator **Sheppard.** How much remains undeveloped? Just approximately.

Col. **Taylor.** About a thousand feet or more, I think.

Senator **Sheppard.** Private parties own the frontage there?

Col. **Taylor.** It is all undeveloped here [indicating on map].

Mr. **Gresham.** I can give you that in a minute.

Col. **Taylor.** I can tell you exactly in a moment.

Mr. **Gresham.** The original bill provided for the extension of it as far as Fifty-sixth or Fifty-seventh Street, and now it is improved by the Southern Pacific from Forty-first to about Forty-fifth or Forty-sixth. It is about half of their property.

Senator SHEPPARD. But the Government has not constructed the channel as far——

Mr. GRESHAM. No, sir; it has not. But there is no occasion for that until there are improvements there.

Senator SHEPPARD. Do I understand that some corporations or private parties would be expected to erect docks there before the Government would deepen the channel?

Col. TAYLOR. There has got to be some desire for it. There is no occasion for it at all up there.

Col. NEWCOMER. The channel could probably be extended as rapidly as they could put in their construction.

Col. TAYLOR. As rapidly as they show any need of it.

Senator SHEPPARD. There has been no proposition for the owners to develop the channel on condition that the Government extend it?

Mr. GRESHAM. And the minute they did that, Senator, they would excavate largely from the channel that the Government would open anyhow, in order to protect it, to build up their property.

Col. ABBOT. They would get the material out of the channel they have dug out at first.

Senator SHEPPARD. You gentlemen can not authorize a survey until you get this additional data that you have sent for?

Col. NEWCOMER. Of course that is for the board to decide. It decided before to await that information.

Senator SHEPPARD. Col. Gresham desires to request, and I want to second it, that if you can possibly do so, you order it so that we could get the required data in time to be acted on——

Mr. GRESHAM. Would it do any harm for me to write some of the ship agents in connection with that information that you desire, and ask them what depths of vessels they charter or bring in there now, and whether or not they are guided by the depth of water, and whether larger vessels would come there if they had deeper water, or something to that effect? Those are the difficulties.

Col. TAYLOR. The board would be glad to have any information that throws any light on the subject of any sort or kind.

Mr. GRESHAM. I wanted to get that, because it would have to come from them.

Col. TAYLOR. Anything of that kind that you can get that bears on the subject will be acceptable.

Mr. GRESHAM. It is very clear to my mind that a man is not going to bring a vessel in drawing 35 feet when he has only got 30 feet, when freight is as high as it is at this particular time.

Senator SHEPPARD. What about the Port Bolivar project?

Col. NEWCOMER. The board has not yet read that report. It is to be considered by the board at this meeting if we can get to it.

Senator SHEPPARD. Are you going to speak about Bolivar?

Mr. GRESHAM. I think Col. Taylor knows about as much as I do on that. I would be perfectly willing to come before the board to give them information if they so desire; any information that I can give them.

Senator SHEPPARD. The Texas City matter will come up on March 7. Is that true?

Col. NEWCOMER. I think that was set for hearing. The board issued notices.

Senator SHEPPARD. I just wanted to be sure that it was not overlooked.

Col. NEWCOMER. I think the hearing has been set for Mr. Moore. I think he wired and had an engagement made for March 7.

HEARING BEFORE THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS IN REFERENCE TO SABINE-NACHES CANAL, TEX., ACT OF MARCH 4, 1915.

JUNE 20, 1916.

Col. Abbot, Col. Winslow, Col. Newcomer, Col. Biddle, Col. Flagler, and Col. Keller were present.

Senator Morris Sheppard, Hon. Martin Dies, Member of Congress, and Mr. G. N. Bliss appeared before the board in reference to the above subject.

Senator SHEPPARD. Gentlemen, I understand that the report on the survey with reference to the revetment at Port Arthur has been made.

Col. ABBOT. Yes, sir.

Senator **Sheppard**. We simply want to bring the matter to the attention of the board again and to say that we hope the board will decide that the Government is under obligation to prevent the disfigurement and the injuries that are being occasioned by the canal. We have never contended that the revetment was necessary to navigation at all. It is necessary to repair an injury that has been occasioned by an adopted project of the Government. The damage is being done. There must be a means of reparation somewhere. If it is not proper for this board to grant it, or for the War Department to grant it, it may be necessary for us to introduce a bill for damages and present the same to the Claims Committee of the Senate and House. It is just a matter of methods.

I do not know whether this board ever takes into consideration the fact that the projects it recommends may occasion injury to riparian interests, or whether any estimates for certain measures that are necessary to prevent that injury are made. I do not know what the practice of the board is in that regard.

Col. **Abbot**. There are certain decisions of the courts; for instance, where you dredge a channel through the marshes and the sides fall in, it is held that there is no reimbursement to the riparian owner that lies against the United States for the caving in due to the digging of the channel. That is the latest decision I have seen.

Senator **Sheppard**. When we were attempting to have Cypress River improved between Jefferson and Shreveport, one of the reasons urged against that was that innumerable claims for damages would be presented.

Col. **Abbot**. Flowage is in a different category from caving in. There have been a number of more or less conflicting court decisions, but the general tendency is that where damage is done, due to an improvement of an existing navigable water, the damages done to the shore only, other than due to change of the water level produced by the works, then the Government is not responsible.

Senator **Sheppard**. This damage was not occasioned by the improvement of an existing waterway, but by the construction of a waterway through the soil.

Col. **Abbot**. There is a different question there, undoubtedly.

Senator **Sheppard**. I think so. I simply wanted to bring that point to the attention of the board. It is the only ground on which we have to stand in this matter. The damage is there, and we shall attempt to find some way to secure a remedy for it. I understand from a representative of Port Arthur that it will secure releases from the owners of the land so that this can not be considered a precedent by the owners not within the city limits. I notice in the report that it is stated that if the revetment is established within the city limits the people who own land outside the city limits will then claim similar damage and will appeal for a remedy and for an appropriation.

Congressman Dies and also Mr. Bliss are here, and I should like to have them say a few words.

Col. **Newcomer**. You speak of releases outside the city limits. As I understand, they now propose a revetment for a portion of the front within the city limits. Would releases be secured there for remaining portions?

Senator **Sheppard**. Mr. Bliss will answer that question.

Mr. **Bliss**. Yes, sir. All the city of Port Arthur asks is that the canal be confined within the city limits. That we discussed the last time I was up there. We do not care; it is immaterial to us what kind of a revetment goes in or how it is constructed. The canal is sloughing off, and it will undoubtedly continue to do so.

Col. **Newcomer**. Is it not true, Mr. Bliss, that the rate of sloughing is diminishing? In other words, that this goes back simply on a shelf, which will finally adjust itself without any material damage——

Mr. **Bliss**. That is true to a certain extent. But we are building a levee now, for storm protection, within 25 or 35 feet of the ends of the canal. If that goes back that far, in time, which it undoubtedly will, up to the high lands where we are asking the canal to be confined, there is no doubt but what it will reach the levee in the course of time.

Senator **Sheppard**. And undermine it.

Mr. **Bliss**. It is sloughing off, and everything will go into the canal. At the upper end it is now 20 or 25 feet out of the right of way granted. You can go along there now and see flowers, shrubbery, and orange trees and things of that kind going over into the canal.

As I stated before, if the Government will undertake to revet that canal, we will furnish them what additional right of way is necessary, and in addition to that we will give them the releases. There are property owners below and above the city; that is, outside of the territory that we propose to have the Government improve.

Col. NEWCOMER. The plan submitted by the district officer does not cover the whole city front?

Mr. BLISS. No; I understand that; but the lower part, the contour of the land is much lower, and it is of a clay substance. It is in the upper part where we are having our trouble——

Col. NEWCOMER. The information submitted indicates that the cheapest form of revetments considered would cost something over $50,000. The district officer's estimates run up to $160,000. Is it not probable that this area of land that may be involved, and which is gradually diminishing, would be worth a good deal less than this cost of protection?

Mr. BLISS. No; I do not think so—not within the city limits, because that goes right down through our breakwater. The best and the highest land we have is where the right of way for this canal was given along the lake front.

Col. NEWCOMER. It seems to be quite a distance from any building.

Mr. BLISS. It is 60 feet.

Col. NEWCOMER. That is merely an outbuilding of some kind, is it not?

Mr. BLISS. It is practically 100 feet from our main buildings, but it gives a very unsightly appearance to our canal, and the greatest danger is in regard to this revetment that we are putting up for storm protection. We are spending down there $750,000, raising railroad tracks, and we are leveeing the whole town. It is a big undertaking. Of course, down the canal front is the lease of our leveeing, because there is where the high land is. It is on the back where the levee is the highest, and it is only a question of time at the upper end of the city, when it will slough off and take our levee into the canal, too.

Senator SHEPPARD. I would like to ask this question: Do you ever provide, in establishing new projects, for prevention of injury to riparian interests by works that otherwise might not be essential to navigation?

Col. NEWCOMER. It is rather a usual thing—I mean it is not an uncommon thing, at least, to provide revetment where it is originally expected that it will be required in order to maintain the channel.

Senator SHEPPARD. If you could have foreseen this at the time this canal was being constructed, might not the revetments have been constructed?

Col. NEWCOMER. They would at that time have required the releases that are now proposed. In other words, if it had been foreseen, then it is very likely that the United States would not have assumed any responsibility for damage to that property. The tendency in all works now is to require local interests, in a case of this kind, to release the Government from any claim for damages.

Senator SHEPPARD. That is perfectly proper. At the same time the principle has been established that you will provide for prevention of injury if you consider the project all right, even if you could not get the release. We ask the board to consider it from that standpoint.

Col. ABBOT. In Texas we had one of those cases there between Long Beach and the outer levee where the right of way was a little bit too narrow, and we were afraid to start in unless we got a broader right of way. That is what Col. Newcomer was speaking of, getting more land rather than going beyond the limit.

Senator SHEPPARD. I have no doubt that if the people of Port Arthur had foreseen that the improvement would be a disfigurement they would not have given any release.

Col. ABBOT. I do not think they would have had it built there if they knew it was going to cave in.

Senator SHEPPARD. We simply want to leave that point with you for consideration.

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64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1757.

MERMENTAU RIVER, LA.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF MERMENTAU RIVER, LA.

DECEMBER 15, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration.

WAR DEPARTMENT,
Washington, December 14, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated December 11th instant, together with copies of reports from Maj. E. H. Schulz, Corps of Engineers, dated September 20, 1915, with map, and July 31, 1916, on a preliminary examination and survey, respectively, of Mermentau River, La., made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully.

WM. M. INGRAHAM,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, December 11, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Mermentau River, La.

1. There are submitted herewith for transmission to Congress reports dated September 20, 1915, with map, and July 31, 1916, by

Maj. E. H. Schulz, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act approved March 4, 1915, of Mermentau River, La.

2. Mermentau River is formed by the junction of Bayou des Cannes and Bayou Nezpique. From its source to the Gulf of Mexico it is 71½ miles long, and passes through Lake Arthur, Grand Lake, and Upper and Lower Mud Lakes. The original and existing project, adopted in 1892 and modified in 1897, provides for the securing of the natural channel in the Mermentau River and tributaries by removing obstructions throughout the improvement and securing a suitable channel through Lower Mud Lake with dikes to concentrate the action of the current, supplemented by dredging. To June 30, 1916, $26,115.25 had been expended for improvement and $12,759.88 for maintenance, a total of $38,875.13, including expenditures for snagging in Bayous Nezpique and des Cannes. In the river proper the depth is generally in excess of 5 feet at mean low gulf, but on the bar at the mouth and in the upper and lower portions of Grand Lake the depth is less. To meet the present needs of commerce the district officer recommends the adoption of a project stated as follows:

> Improving Mermentau River, by removing obstructions and by dredging and placing guide marks, to provide a channel 5 feet deep at mean low gulf and 60 feet wide at bottom, from the mouth to the junction of Bayous des Cannes and Nezpique, at an estimated cost of $30,000 and $3,000 annually for maintenance.

The division engineer concurs in the recommendations of the district officer.

3. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors and attention is invited to its report herewith, dated September 12, 1916. The board concurs in the opinion of the district officer and the division engineer that additional improvement is warranted by existing and prospective commerce. It believes, however, that a channel of the depth proposed can not be maintained over the bar at the mouth at reasonable expense, and that the depth in Lower Mud Lake need not be greater than that at the entrance. The board recommends that the existing project be modified so as to provide for a channel 5 feet deep at mean low gulf and 60 feet wide at bottom in the Mermentau River above Lower Mud Lake to its source at the junction of Bayous des Cannes and Nezpique and for marking channels where necessary, at an estimated cost of $21,100, and not exceeding $3,000 annually for maintenance.

4. After due consideration of the above-mentioned reports, I concur in the views of the Board of Engineers for Rivers and Harbors and therefore report that the further improvement by the United States of Mermentau River, La., is deemed advisable to the extent of providing a channel 5 feet deep at mean low gulf and 60 feet wide at bottom from the upper end of Lower Mud Lake to the junction of Bayous des Cannes and Nezpique, at an estimated cost of $21,100 for first construction and not exceeding $3,000 annually for maintenance, including the maintenance of the natural depth of about 4 feet, with width of 60 feet, over the bar and in Lower Mud Lake. The entire amount should be made available in one appropriation.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
September 12, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following is in review of the district officer's reports, authorized by the river and harbor act of March 4, 1915, on preliminary examination and survey of Mermentau River, La.

2. The Mermentau River is formed by the junction of Bayou des Cannes and Bayou Nezpique, flows in a southwesterly direction 71½ miles, and empties into the Gulf of Mexico 15 miles east of Calcasieu River. The river passes through Lake Arthur, Grand Lake, and Upper and Lower Mud Lakes. It is the channel of approach to Bayou Plaquemine Brule and Bayou Queue de Tortue, both under improvement under separate projects (19 miles and 14 miles, respectively), to Bayous Nezpique and des Cannes, which are navigated for distances of 25 miles and 10 miles, respectively, and to Bayou Lacassine, which is navigable for some distance above its mouth. It is also connected with the partially completed intracoastal waterway.

3. The existing project, adopted in 1892 and modified 1897, provides for the securing of a natural channel in the Mermentau River and tributaries by removing obstructions throughout the improvement and the securing of a suitable channel through Lower Mud Lake by means of dikes, supplemented by dredging, at an estimated cost of $23,615.25. The cost of maintenance and channel dimensions are not specified in the project. To June 30, 1916, $38,875.13 had been expended on Mermentau River, Bayou Nezpique, and Bayou des Cannes.

4. At present the depth over the bar at the mouth of the river is 3 to 4 feet at mean low gulf; in the lower end of Grand Lake 3 feet; in the upper end of Grand Lake about 4 feet; in the river proper the depth is generally in excess of 5 feet.

5. The commerce is of a miscellaneous character and during the past four years has averaged 35,800 tons, valued at $717,600. There are no railroad facilities on the lower 53 miles of the river, and dependence is placed upon the waterway for transportation.

6. The improvement contemplated is dredging at the mouth and in the river and lakes where needed and marking the channel. Estimates are given as follows:

(*a*) Channel 4 feet deep at mean low gulf, 60 feet bottom width through the Gulf entrance, Lower Mud Lake, Upper Mud Lake, and lower end of Grand Lake; and 5 feet deep and 60 feet wide for the upper end of Grand Lake and in the cut-off	$15,000
Maintenance	1,800
(*b*) Channel 5 feet deep and 60 feet wide throughout	30,000
Maintenance	3,000
(*c*) Channel 6 feet deep and 60 feet wide throughout	60,000
Maintenance not given.	

The district officer regards (*a*) inadequate to meet the requirements of navigation and the cost of (*c*) as excessive. He believes the locality worthy of improvement in accordance with estimate (*b*).

The division engineer concurs in the recommendations of the district officer.

7. In view of the considerable commerce on this stream, the good prospect of increase, the comparatively small expenditure in the past, the reasonable proportion between estimated cost and probable benefit, and the fact that a large part of the adjacent country is dependent upon the river for transportation, the board concurs in the opinion of the district officer and the division engineer that additional improvement is warranted. It believes, however, that a channel of the depth proposed can not be maintained over the bar at the mouth at reasonable expense, and that the depth in Lower Mud Lake need not be greater than that at the entrance. At these places work of construction might well be omitted, thus reducing the first cost, and work of maintenance be confined to preserving a navigable channel of natural depth, viz, about 4 feet. The board therefore recommends that the existing project be modified so as to provide for a channel 5 feet deep at mean low gulf and 60 feet wide at bottom in the Mermentau River above Lower Mud Lake to its source at the junction of Bayous des Cannes and Nezpique, and for marking channels where necessary, at an estimated cost of $21,100 and $3,000 annually for maintenance. The board does not believe that the commerce on the river justifies a greater annual expenditure than this; should it not be found sufficient to maintain a channel of full dimensions, it should be used to best advantage. The entire amount should be made available in one appropriation.

8. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects so related to the project proposed that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interests of navigation.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF MERMENTAU RIVER, LA.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
New Orleans, La., September 20, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Mermentau River, La.

1. The following report on preliminary examination of Mermentau River is submitted, under provisions of the river and harbor act of March 4, 1915, and in compliance with department instructions of March 15, 1915. A reconnaissance of the stream was made on July 5, 1915.

2. A general map of the stream accompanies this report. This map shows the general location of the stream and adjacent country, from its source at the juncture of Bayou des Cannes and Bayou

Nezpique, to its mouth in the Gulf of Mexico, and gives the distances and more important points along the stream.

3. Mermantau River lies in southwestern Louisiana, and is formed by the junction of Bayou des Cannes and Bayou Nezpique, 2 miles above the town of Mermentau, La. It is 71½ miles long, and flows generally southwest and empties into the Gulf of Mexico, 15 miles east of Calcasieu River and 64 miles west of Vermilion River. The area of its watershed is about 2,400 square miles. The stream, in its natural state, has various widths and depths. It passes through four lakes on its way to the Gulf of Mexico, viz, Lake Arthur, Grand Lake, and Upper and Lower Mud Lakes. Variations of water surface in the upper river are from 8 to 12 feet, due to floods, and in the lower river 1 to 3 feet, due to tide and winds. The through depth from Mermentau to the Gulf is about 3½ feet at mean low Gulf, and about 6½ feet at high stage. The prevailing condition may be considered as that of mean low Gulf. During northers in the winter, the level may go to 1 to 2 feet lower for a few days. The river is not generally higher, except after rains or southerly winds. The upper tributaries are drawn upon extensively for rice culture from May to September.

4. Bayou des Cannes is a large stream, but is not under improvement. Bayou Nezpique is considered under improvement for 25 miles, but no actual work has been done since October 6, 1906. Bayou Plaquemine Brule, which joins Bayou des Cannes 1¾ miles above its mouth, is under active improvement for 19 miles.

The Southern Pacific Railroad Bridge crosses the stream at Mermentau, mile 69½ above the mouth. This bridge has a draw span of 34-foot width, and a vertical clearance at mean low gulf of 14 feet. This is the only bridge between the source, at mile 71½, and the mouth.

At 57½ miles from the Gulf of Mexico, the Mermentau River is joined by Bayou Queue de Tortue from the east, now under improvement for 14 miles. Proceeding downstream, the river debouches at mile 53 into Lake Arthur, which lake has a length of 6 miles and a maximum width of about 1½ miles. At the upper end of this lake is the town of Lake Arthur. At the 36-mile point, the stream again debouches into Grand Lake, through which lake it runs for 11½ miles.

The proposed Mermentau-Calcasieu section of the intracoastal waterway will enter the river from the west, at the 37-mile point, just above entrance into Grand Lake, and the existing Mermentau-Vermilion section enters from the east, about 12 miles from upper end of Grand Lake and 9½ miles from the lower end. Bayou Lacassine is a navigable stream, and enters Grand Lake about 5 miles to the west of the upper end of Grand Lake.

The mouth of Mermentau River is 230 miles distant from Southwest Pass of Mississippi River, via Gulf, and 105 miles distant from Galveston, Tex., via Gulf. Grand Lake is 212 miles distant from New Orleans, via proposed inland waterway, and 100 miles distant from Port Arthur, Tex., via proposed inland waterway.

5. A general description of the river, by sections, beginning at the Gulf, is as follows:

Mile 0 to mile 3: The stream has widths varying from 500 to 800 feet, with minimum center depth of 8 feet, except over the bar at mouth, where depth is about 3½ feet. This channel is good, generally, although there are numerous mud flats on account of the great width. The banks are marshy, with elevation of 0.5 foot to 2 feet above mean low gulf.

Mile 3 to Mile 6: At mile 3 to mile 6 the river widens out into Lower Mud Lake. This lake has a maximum length of about 3 miles, width about 1 mile. Through this lake is an exceptionally bad stretch of channel, the depth in places not being more than 3 feet, with narrow width and course unmarked.

Mile 6 to mile 13: Width ranges from 325 feet to 700 feet; depths, 8 to 13 feet. At mile 6.5 on the right bank is Oak Grove Ridge, with an elevation of 11 feet. Just below Oak Ridge is bad sea marsh. The left bank is all marsh. The stream, from mile 6 to mile 7, is from 400 to 650 feet wide and has center depth of 8 feet. From mile 7 to mile 8 the stream is 400 to 550 feet wide, with minimum center depth of 10 feet. At the 7.75 mile point is located the Mermentau Lock and Dam (for report on which see H. Doc. No. 1290, 62d Cong., 3d sess.). From mile 7 to mile 8, on right bank, is a road; on left bank trees and marsh. From mile 8 to 9 the stream has a width of from 300 to 400 feet, with minimum center depth of 11 feet. Banks vary on both sides from high land to marsh. From mile 9 to mile 11 the stream has a depth of 14 feet, with widths from 325 to 700 feet. The elevation of left bank is 1.7 feet at marsh, 8 feet at Vaughn Settlement, and 4.6 feet at Grand Chenier. On the right bank elevations vary from 1 to 4.5 feet. There are houses on both banks, but more on the left bank. Near mile 9, on the left bank, is the Grand Chenier Settlement, which is the principal point of the thickly settled ridge called Grand Chenier Ridge. The ridge at this point is a little more than one-half mile wide, the highest point on which is about 11.5 feet, mean low gulf. From mile 11 to mile 13 the stream is 500 to 700 feet wide, with minimum center depth of 13 feet; banks, 1 foot to 3 feet. Several houses on both banks. Near mile 11, on the left bank, is the Vaughn Settlement.

Mile 13 to mile 16.5: This portion is known as Upper Mud Lake, with a maximum width of about 3,000 feet. The banks are marshy. The channel through this lake is about 6 feet deep and 50 feet wide in most places, but is not marked and very difficult to find, as it winds around an island and runs from one side of the lake to the other. The lake depth is only 1.5 to 2 feet outside the channel, and possibly a reasonably straight channel through this lake will require some dredging, and certainly some good marks or guide piles.

Mile 16.5 to mile 24: From mile 16.5 to mile 19 the stream has a minimum depth of 11 feet, maximum 38 feet, and width from 260 to 420 feet. Banks are low marsh from 1 to 2.5 feet high. At mile 19 the Little Chenier Ridge approaches the river. This ridge is about 250 feet wide and is well settled. It is 4 to 6 feet above mean low gulf and extends about 10 miles out into the marsh.

Mile 24.5 to mile 36: This portion is through Grand Lake; the ruling depth is 6 feet. At the lower southwest portion of Grand Lake there is a shoal for about 7,000 feet where the lower Mermentau River leaves Grand Lake, the minimum depth of water being 3.5 feet mean low gulf. At the entrance to Grand Lake (at the 36-mile point) there is a shoal extending about 4,700 feet, with a depth of 3.5 feet at mean low gulf.

Mile 36 to mile 47: From the 36-mile point to the 47-mile point (Grand Lake to Lake Arthur) the stream is from 700 to 1,000 feet wide with center depth of 15 feet. The banks vary throughout, being swampy, high, and wooded, and open marsh. There are a few houses. The present cut-off, C–D, on this portion at mile 40.75 is about 1,000 feet long, 20 to 24 feet wide, and 4 feet deep, and was made in order to avoid the long bend in the river at this point. The saving in distance is about 1½ miles.

Mile 47 to mile 53: This portion is called Lake Arthur and has a width from 1,200 feet to about 8,000 feet and a maximum depth of about 7 feet. At the upper end, on the right bank, is the town of Lake Arthur, with railroad connection to Lake Charles. A ferry crosses here to Shell Beach. Both banks of the lake are fairly high and well inhabited. There are several islands of timber in the lake, and, unlike most lakes, this sheet of water is rather crooked.

Mile 53 to mile 71½: From the 53-mile point to the 71½-mile point the stream is 350 feet to 800 feet wide and lies in a narrow valley or swamp about 1 mile wide and heavily timbered. The lower portion, from mile 53 to mile 59½, has some snags. The width of the stream is sufficient, however, to permit boats to navigate with reasonable safety. From mile 59.5 to mile 71½ the stream is in an excellent condition, 350 feet wide and 40 feet deep; the banks are generally low, swampy, and heavily timbered. The town of Mermentau and the Southern Pacific Railroad Bridge are at mile 69½.

6. *Present project.*—The improvement of this stream was first authorized by Congress in 1892, based on survey and report dated August 13, 1891, printed in Annual Report for 1891, page 1862, and the project provides for the securing of the natural channel in river and tributaries by removing obstructions throughout the improvement and for the securing of a suitable channel through Lower Mud Lake, with dikes to concentrate the action of the current, at an estimated cost of $23,615.25. In 1897 dredging was approved to supplement action of the dikes in Lower Mud Lake. No approved estimate of cost or maintenance nor channel dimensions or limits of improvement were determined by Congress. Under the project, up to June 30, 1915, the sum of $26,115.25 has been expended for improvement and $11,937.73 for maintenance, a total of $38,052.98.

7. Under the project obstructions were removed from 20 miles of river above Lake Arthur in 1892 and 1893. In 1897 and 1898 channels were dredged through two shoals in Lower Mud Lake to an average depth of 8 feet and width of 50 feet, and two pile and brush dams, 2,500 feet and 3,000 feet long, respectively, were constructed. In 1899 the channels, for a length of 3,877 feet, were redredged to a depth of 6½ feet. In 1914 a shoal of 1,200 feet in Lower Mud Lake was dredged to a depth of 5 feet and a width of 50 feet.

8. The matter of the improvement of the Mermentau was reported on in House Document 1290, Sixty-second Congress, third session, with a view to the construction of a lock and dam to maintain the level of Grand Lake and the inland waterways of Louisiana. To prevent interruption of navigation by north winds, the district officer considered it necessary to dredge to a greater depth, or to construct a dam; also that the dam would have an incidental value in preventing flow of salt water into the lake. He presented a plan for lock and dam to cost $173,000, and was of opinion, owing to mutual benefits

to rice and navigation, that the rice growers should pay one-half its cost and operation. The Board of Engineers not being convinced of the necessity of the lock and dam in the interests of navigation, held a hearing, where it developed that local cooperation was not practicable. The opinion of the board was that the effect of the dam would be only local and limited to short periods of comparative infrequency, and that it was not advisable for United States to undertake construction, which was concurred in by the Chief of Engineers.

9. *Commercial statistics.*

Articles.	Quantity.	Units.	Short tons.	Valuation.	Average haul or distance freight was carried.	Ton-mile statistics.
Brick	26,000	Number	65	$195	45	2,925
Coal	40	Tons	40	240	50	2,000
Cotton	2,000	Bales	500	100,000	20	10,000
Cotton seed	2,800	Sacks	84	2,520	20	1,680
Corn	19	Tons	19	665	10	190
Eggs	175	Cases	5	1,300	60	300
Fish	10	Tons	10	2,000	30	600
Feed, ground	2	.....do	2	60	10	20
Hay	350	Bales	19	350	10	190
Hides	375	Number	9	937	60	540
Iron and steel	60	Tons	60	2,400	50	3,000
Lime	50	Barrels	5	50	45	225
Logs	1,010,000	Feet	5,050	101,000	45	227,250
Lumber	1,000,000	.....do	2,000	20,000	40	80,000
Live stock	90	Head	22	2,200	50	1,100
Machinery	160	Tons	160	16,000	50	8,000
Oil, fuel	100,000	Barrels	15,500	124,000	60	930,000
Oil, refined	300	.....do	46	1,518	60	2,760
Molasses	150	.....do	37	1,480	40	1,480
Miscellaneous merchandise	2,000	Tons	2,000	200,000	30	60,000
Moss	20	Bales	3	120	60	180
Oats	500	Bushels	7	231	10	70
Potatoes	100	Barrels	9	450	10	90
Rice	16,800	Sacks	672	26,880	40	26,880
Salt	70	Tons	70	210	40	2,800
Shingles	222,000	Number	44	1,100	50	2,200
Sugar	150	Barrels	30	2,400	40	1,200
Wood	270	Cords	270	1,080	30	8,100
Total			26,738	609,386		1,373,780

The main part of this commerce is from Grand Chenier and Pecan Island and adjacent settlement up to Lake Arthur and Mermentau. Lake Arthur is a town of about 1,100 inhabitants; Grand Chenier, 100 inhabitants; Mermentau, 350 inhabitants; and Pecan Island, about 200 inhabitants.

10. The points of rail shipment are at Mermentau and Lake Arthur, both connections of the Southern Pacific Railroad. Timber wharves are located here, and also oil tanks. No railroad facilities exist for the lower 53 miles of the river, and all traffic and transportation are practically dependent on the stream. A small timber wharf exists at Grand Chenier. At the less important points, the natural banks are used. No other features of terminal facilities or wharves are necessary, as the further use of the stream depends upon the products and crops, additional land to be reclaimed, and improvement of waterway.

11. The traffic out through the Lower Mermentau and into the Gulf is at present partially obstructed by a wrecked lock and dam

located at mile 7¾. There is a depth of but 3 to 3½ feet over the dam, and a cable has been placed to prevent passage and possible injury. Commerce must now use the open lock, about 36 feet wide, with oblique approaches and swift currents. The present removal of this dam is the subject of a separate report of this date (see H. Doc. No. 1232, 64th Cong., 1st sess.).

12. It should be noted that the intracoastal waterway now enters Grand Lake from the east, and the proposed canal from the west will enter Mermentau River just above Grand Lake. Rights of way for the latter are now being secured. The completion of this route, with a 5-foot depth and 40-foot width, will stimulate traffic on the main stream and its tributaries.

13. The development of water power over this stream is not applicable. The banks are so low that any increase in elevation is a detriment to the territory concerned. The subject of drainage is connected with the improvement to the extent that better navigation facilities will encourage drainage and reclamation of more of the marsh lands.

14. In regard to the necessity of improvement, inquiry was made of all interested parties, whose replies were briefly as follows:

(*a*) Letter dated April 8, 1915, from Hon. L. Lazaro, Member of Congress of this congressional district, forwarding a letter from Mr. George Hathaway, of Jennings, La., dated April 3, 1915, in which letter Mr. Hathaway states as follows:

"The Mermentau Basin comprises the richest section of all southwest Louisiana. Rice, cotton, and corn are the principal agricultural products. The river intercepts the Intercoastal Canal at Grand Lake, giving outlet east and west before entering the Gulf. The sand bars at and near the mouth of the river prevent any but small vessels from entering, also the route through Grand Lake is too shallow at usual stage of water.

"As to valuable improvements to the river, I should say dredging, clearing stream of logs and other obstructions; making short cut-off at a few places where the distance can be decreased from 1 to 5 miles; deepening the channel at Grand Lake and near the Gulf. Except where the waters spread out at points such as Grand Lake, Lake Arthur, etc., the channel almost all the distance is ample in depth. At the town of Mermentau, crossing of Southern Pacific Railroad, at ordinary stage of water, the channel is about 40 feet in depth. Above Mermentau a short distance there branches the Plaquemine, running to Crowley and now navigable to that city. Farther on the Bayou Cannes branches to the northeast and is navigable to the oil fields for small craft. From this branch the main stream runs in a northerly direction and is called Bayou Nezpique and is navigable for a long distance to the Grand Canal Pumping Plant, about 15 miles. The town of Jennings wishes to construct a canal from the Mermentau to the corporate line. The route and location are already selected and surveyed. With this we have water outlet to the Intercoastal Canal and the Gulf. Now we have served by this highway cities and towns of Crowley, Mermentau, Jennings, Lake Arthur, Grand Chenier, besides many smaller villages.

"The cost of clearing and straightening the channel and deepening at Grand Lake seems to me could not be great, and the benefit is inestimable to a large territory.

"The distance from the Gulf of Mexico to head of the Mermentau River proper as the bird flies is about 40 miles, but as the steamboat bends and twists more than twice that distance. The stream is wide enough at all points for the largest river boats.

"Our greatest trouble is snags, logs, etc., obstructing passage, and sharp bends where a short canal would straighten and shorten. The volume of traffic is now considerable, and steadily increasing."

(*b*) Letter dated August 12, 1915, from J. D. McCall, Grand Chenier, La.:

"In regard to the amount of tonnage of commodities using the lower part of the Mermentau River and going through lower Mud Lake, and especially the commerce to Creole and out in the Gulf of Mexico, will say there are 2 motor boats of about 12 tons each that ply between Mermentau Station, La., Lake Arthur, Grand Chenier, and Creole twice a week, carrying about 10 tons of freight each, which would make about 40 tons per week, making about 2,000 tons per year. Passing through the mouth of the river to Galveston, Tex., there are two schooners that run about nine months in the year, carrying freight of nearly every kind to and from Galveston to Grand Chenier, La., and other inland towns, and amounting to about 1,400 tons.

Besides, there are about a hundred other boats that pass up and down the river through Mud Lake and out of the mouth of the river into the Gulf of Mexico to different ports, ranging in tonnage from 1 to 25 tons.

"I do not think you will find another stream of water in the State that needs an appropriation worse than the Mermentau River, and while you are recommending you will do a great favor to the people of Cameron Parish by recommending the removal of the dam across the Mermentau River located near the west end of the Grand Chenier Island."

(*c*) Letter dated August 15, 1915, from Mr. Ben Castain, Grand Chenier, La. He states that a correct estimate is not possible; five stores get all merchandise through lower route. There are two cotton gins below Lower Mud Lake and two above, making about 2,000 bales, or 500 tons. There is also lumber and fence posts, about 300,000 feet, or 600 tons, and some hides, furs, and game.

(*d*) Letter dated August 17, 1915, from the assistant secretary of the Chicago Title & Trust Co., inclosing petition of boatmen, cattle owners, etc.:

"The petition of the undersigned, captains and owners of boats navigating the lower Mermentau River, of the landowners owning land within the parish of Cameron, of the merchants, farmers, and cattle raisers living along and near the said river, with respect represents:

"That the improvement of the navigation of the Mermentau River is of the greatest importance to your petitioners; that the said river is the only means of transportation they have, and that it is badly in need of improvement; that all obstructions should be removed therefrom, and that by thus removing the obstructions, it will greatly improve the navigation of the said river.

"Your petitioners further represent that the low, wet lands of that section are being improved by leveeing and drainage, and that the tonnage carried by river will greatly increase, due to this cause and the improvement to navigation.

"We, the undersigned, landowners, cattle men, farmers, boat owners, merchants, living along and near the lower Mermentau River, would respectfully beg to call your attention to the shallow and inadequate channel along certain portions of said Lower Mermentau River in upper and Lower Mud Lake, said places being south of Grand Lake and near the mouth of the river, and also the very shallow depth of water on the bar immediately off the mouth of said river in the Gulf; and as we understand the Government will soon have a dredge boat at work on the lower Calcasieu River, which is only a short distance away, we would ask permission to call your attention to the need of deepening and widening the above shallows in said Mermentau River for the benefit of the navigation in said river. There are at present two boats (passenger and freight) running regularly between Creole, Grand Chenier, and Lake Arthur and Mermentau Station on the Southern Pacific road, each making two trips a week. There are also two schooner lines running from Grand Chenier and Creole to Galveston throughout the year. There are also a number of boats running independently making trips to Lake Arthur, Abbeville, Mermentau, and Lake Charles via Cameron, the principal exports being cotton, cotton seed, oranges, cattle, hides, sirup, game, fish, furs, chickens, and eggs. The improvement in the shallows of 'upper and lower Mud Lake and of the bar at the mouth of said river would be of great benefit to the people living in Cameron Parish, as the traffic is not confined only to the river, but is brought from inland to the different shipping points, and said improvement is greatly needed for the better navigation of said river.

"We earnestly hope that it may meet with your views to have the work taken up by the dredge boat which you will have at work in the neighborhood.

J. D. McCall, Notary Public; L. O. Miller, M. D.; S. S. Doland, Farmer; Alcide Miller, Merchant; Thos. W. McCall, Superintendent of Schools; John Eagleson, Farmer; J. N. Miller, Captain; F. J. Hatty; Lloyd Vaughan, President Police Jury; Placide Miller, Farmer; Raphiel Miller; Gustave Gillette."

(*e*) Letter dated August 20, 1915, from Mr. E. C. Canning, representing drainage interests and lands:

"With reference to general conditions of that section in Cameron Parish, La., lying along and contiguous to the lower Mermentau River, between Grand Lake and the mouth of said river, would beg to submit the following as coming under my personal observation during the past three years.

"There have been two freight-carrying and passenger boats running between Creole and Lake Arthur, the *White Lily* and the *Tubeor*, and making two trips per week each, carrying freight and passengers. There have been also, two large schooners, the *E. O. Gladdys* and the *George Lock*, running from Grand Chenier to Galveston, Port Arthur, and Beaumont, making an average of one trip each per month, taking the outside course through lower Mud Lake and out through the mouth of the Mermentau River.

These schooners and motor boats were engaged in carrying freight, such as household and farm supplies, coal, cotton, cottonseed, lumber, oranges, hardware, and farm implements, between the points above mentioned.

"There is also a large motor boat, the *Crescent*, making irregular trips from Grand Chenier to Lake Charles, La., by the outside Gulf route; also making trips to Lake Arthur and Abbeville, La., by the inside river and intercoastal route, carrying cotton, lumber, and miscellaneous freight to and from above points; all of the above making in the aggregate a comparatively large tonnage to and from that section to the ports above mentioned.

"The exports from Creole and Grand Chenier are each year from 1,500 to 2,000 bales of cotton, of an average weight of 500 pounds each, and of value from $80,000 to $120,000; cottonseed from 750 to 1,000 tons, of value from $12,500 to $25,000 each year; game ducks and wild fowl of value from $50,000 to $60,000 each year; fish of value from $20,000 to $30,000 each year; oranges, about 20,000 boxes, of value from $20,000 to $30,000 each year; furs, of value from $25,000 to $50,000 each year; canned sirup, of value $5,000 to $10,000 each year.

"The cattle industry also shows sales of from 1,000 to 2,000 head each year. These latter, however, are mostly driven out on the hoof to the Texas line and shipped by way of the Calcasieu River to Lake Charles, La.

"Most of the total amount of these different exports are returned in freight to Grand Chenier and Creole, La., comprising household and farm supplies, by the above-mentioned boats navigating the Mermentau River and the outside Gulf route, crossing the bar at the mouth of the Mermentau River, and being compelled to use great care and caution in going through the damaged locks of the old abandoned dam lying between Grand Chenier and the mouth of the Mermentau River.

"I have known some of these larger boats to lie to several days when strong winds were blowing at either end of the locks of said dam, being unable to go through until the conditions were more favorable, and even under the most favorable conditions, the danger being ever present owing to the floating timbers in the lock.

"The improvements to lands and works of reclamation in that section in the past three years have also been very marked. The Cameron Drainage District No. 1 has within that time expended $10,000 to $12,000 in digging by dredge a canal 26 feet wide, 6 to 7 feet deep, from Creole to the Mermentau River for better drainage and transportation, for the benefit of farmers and land owners of 35,000 acres of land.

"The Cameron Drainage District No. 2 has also in that time expended nearly $40,000 in building levees and digging canals and installing large floodgates for the reclamation and better drainage of 16,000 acres of land lying along the Mermentau River between Upper and Lower Mud Lakes, benefitting a large number of landowners and farmers, thereby enabling them to increase the acreage of cultivatable land, which is being planted in cotton, corn, and truck, thus promising a gradually increased tonnage in the Mermentau River and for the outside course.

"In addition to above improvements, individual landowners are at work building levees and digging canals on from 5,000 to 10,000 acres along the river. The farmers, merchants, and landowners are disposed to the improving of their lands, and with improved and better facilities for the transportation of their products the tonnage will increase each year.

"The section is a very fertile country and only needs better protection of the lands and good transportation, which will be brought about by the removing of all the present obstructions in the lower Mermentau River and deepening parts of the channel in Lower Mud Lake and removing the bar at the mouth of the river.

Name of owners.	Acres.	Price.	Amount.
Chicago Trust & Title Co.	100,000	$5	$500,000
Cameron Drainage District No. 1	35,000	5	175,000
Cameron Drainage District No. 2	16,000	10	160,000
Ulrich Co., Chicago	35,000	5	175,000
Eugene Miller	7,000	10	70,000
Various	10,000	10	100,000
	203,000	....	1,180,000

Products and industries.

About 2,000 head of cattle at $30	$60,000
Crops of cotton, 2,000 bales each year, at $60	120,000
Cotton seed, 750 to 1,000 tons each year	25,000
Crops of corn, estimated at 50 cents per bushel, each year	50,000
Crops of oranges, estimated, each year	30,000
Game ducks and other fowl, each year	60,000
Fish, each year	30,000
Canned sirup, each year	10,000
	385,000

"Approximate acreage and valuation of lands, products and industries lying in and contiguous to the lower Mermentau River, $1,180,000 plus $335,000, $1,565,000."

(*f*) Letter dated August 25, 1915, from Mr. Lloyd Vaughan, president of police jury, Cameron Parish, and resolution of the police jury, as follows:

"Inclosed please find copy of resolution this day passed by the police jury with reference to improving the navigation of the Mermentau River. The people of the parish of Cameron are in one accord as to the necessity of this improvement.

"Hoping that it will meet your approval, and that you will be able to move in the matter without delay, we are,

"Respectfully, yours,

"LLOYD VAUGHAN,
"*President, Police Jury, Parish of Cameron.*"

"RESOLUTION OF THE POLICE JURY OF THE PARISH OF CAMERON.

"*Be it resolved by the Police Jury of the Parish of Cameron, State of Louisiana*, That—

"Whereas the only means of public transportation in the parish of Cameron is by water, there being no railroads in the parish; and

"Whereas the Mermentau River as a means of transportation is of vital importance to all the inhabitants of the parish of Cameron; and

"Whereas this river has been obstructed in various ways and the depth of water has been decreased and the navigation thereby impaired; and

"Whereas the board of United States Engineers have made an investigation into the matter and know the needs and necessities of the river for the purpose of improving navigation; and

"Whereas such improvement would be of vast importance to the people of the parish of Cameron: Therefore be it

"*Further resolved by the Police Jury of the Parish of Cameron*, That his honor, Edward H. Schulz, major, Corps of United States Engineers, be, and he is hereby, petitioned, to use his utmost efforts in having the obstructions removed from the Mermentau River and its navigation improved, such improvement it is believed by this body to be of vital importance to the people of the parish of Cameron, as well as all other persons owning or controlling interests in said parish.

Be it further resolved, That a copy of this resolution be forwarded to Maj. Edward H. Schulz.

"I hereby certify the above and foregoing to be a true and correct copy of a resolution passed by the police jury of the parish of Cameron on the 25th day of August, 1915.

"BEN CASTAIN, *Secretary.*"

CAMERON, LA., *August 25, 1915.*

(*g*) Letter dated August 31, 1915, from Mr. Wesley P. Vaughan, Lake Arthur, La.:

"There are two boats making two trips a week apiece regular all the year round, and others at times from Upper and Lower Mermentau River, between Mermentau, Lake Arthur, Grand Chenier, and Creole and also to Cameron by outside route, and there are boats going down this river to Port Arthur and Galveston, and navigation is getting bad in the Lower Mormentau River. There is not water enough in places, and the river is filling in in places. I would recommend to dredge the Lower Mermentau River to its full width and 12 feet deep from in the Gulf to above Grand Lake, and remove the old dam."

The general desire of the above-named interests is that some relief and improvement should be given to the channel at the wrecked dam, and in Upper and Lower Mud Lake, and over the bar at the mouth of the stream. No dimensions of channel are stated in the act of Congress directing the examination.

15. As nearly as can be determined from the above information. the commerce below Grand Chenier and going out the mouth of the river consists of two schooners per month to Galveston, Port Arthur, and Beaumont, also a large motor boat irregularly to Lake Charles, and perhaps a hundred small hunting, fishing, and pleasure craft plying irregularly out into the Gulf. There are also two passenger and freight boats weekly from Lake Arthur, as far down as Creole Ridge and Canal. Thus about 1,000 to 2,000 tons are carried in and out over the stream below Grand Chenier of a value of perhaps $100,000 to $150,000. Of the above, about 500 tons are cotton, outbound to Galveston or Port Arthur, and about the same tonnage of household and miscellaneous supplies are brought in. The quantities of cotton exceed the amount obtained under the usual annual investigation. The acreage of the vicinity under drainage improvement is about 60,000 acres, which will in time, of course, add to the traffic.

16. As already stated, the depth through Lower Mud Lake and outer bar is not over 3 to 3½ feet, and through Upper Mud Lake the channel is ill defined, and possibly also shoals in places. The cutoff, C–D, is narrow, and there are shoals at the upper and lower ends of Grand Lake. In view of the above considerations, it is believed that some improvement should be provided, if it can be made at a reasonable cost, and to determine this it is recommended that a survey and estimate be prepared.

EDWARD H. SCHULZ,
Major, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., December 3, 1915.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded.

2. I have personally examined this river and find that its physical characteristics are, except at a few points, unusually favorable for navigation. The ridges near the mouth are practically islands, being separated from the highlands north by very wide marshes, so that the inhabitants of these ridges will probably be always dependent on water transportation. Much recent reclamation work near the mouth was noticed, and navigation seems likely to increase.

3. If, as is believed to be the case, this river can be improved at comparatively small expense sufficiently to satisfy the present and immediately prospective demands of commerce, it is my opinion that it is worthy of such improvement, since it would then become one of the important feeders of the intracoastal waterway. The recommendation of the district officer that a survey be authorized is concurred in by me.

J. C. SANFORD,
Colonel, Corps of Engineers,
Division Engineer.

[Third indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
January 12, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. For reasons stated herein the board concurs with the district officer and the division engineer in recommending a survey in order to

determine the extent and advisability of the improvement. It is recommended that estimates be prepared for depths of 5 feet and 6 feet, including estimates for annual expense of maintenance.

For the board:

W. M. Black,
Colonel, Corps of Engineers,
Senior Member of the Board.

SURVEY OF MERMENTAU RIVER, LA.

War Department,
United States Engineer Office,
New Orleans, La., July 31, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Survey, plan, and estimate, improvement of Mermentau River, La.

1. In compliance with department instructions of January 21, 1916, I have to submit the following plan and estimate for improving the Mermentau River, La. This report is supplementary to the preliminary report made by this office on September 20, 1915.

2. Additional information as to commerce has been obtained, as follows: The commerce for 1914 was stated at 26,738 tons, valued at $609,386, and 1,373,780 ton-miles. The statistics for 1915 have just been compiled, and show the commerce to have been 24,535 tons, with a valuation of $913,785, an average haul of 42 miles, and a total of 1,044,840 ton-miles. The commerce over the bar of the river in 1915 was 930 tons, valued at $53,215. The commerce above Lake Arthur was 15,935 tons, valued at $402,241; below Lake Arthur 16,682 tons, valued at $573,200. The total of this tonnage exceeds the tonnage of 24,535, on account of the overlapping of some of the traffic on the several courses of the river.

The 1915 commerce in detail is as follows:

Articles.	Quantity.	Units.	Short tons.	Valuation.	Average haul or distance freight was carried.	Ton-mile statistics.
Brick	40,000	Number	100	$300	10	1,000
Coal	2,260	Tons	2,260	9,040	10	22,600
Corn	500	Bushels	140	4,900	40	5,600
Cotton	1,350	Bales	337	67,400	20	6,740
Cotton seed	5,000	Sacks	150	4,500	20	3,000
Eggs	200	Cases	6	1,560	60	360
Fish	10	Tons	10	2,000	20	200
Feed, ground and grain	315	do	315	9,450	10	3,150
Fertilizer	25	do	25	850	40	1,000
Furs	150,000	Number	37	19,610	50	1,850
Hides	50	Tons	50	5,000	60	3,000
Lime	100	Barrels	10	100	50	500
Logs	600,000	Feet	3,000	12,000	30	90,000
Lumber[1]	1,472,000	do	2,944	29,440	50	147,200
Live stock	3,500	Head	875	175,000	50	43,750

[1] In this region 10 pounds of rough log=1 board foot; 1 board foot finished lumber=4 pounds. Value, $20 per thousand feet, or $4 per ton, rough.

Articles.	Quantity.	Units.	Short tons.	Valuation.	Average haul or distance freight was carried.	Ton-mile statistics.
Machinery	270	Tons	270	$27,000	50	13,500
Miscellaneous merchandise	2,000	.....do	2,000	200,000	30	60,000
Oats	500	Bushels	7	231	10	70
Oil, fuel	52,140	Barrels	8,082	64,656	60	484,920
Oil, refined	300	.....do	46	1,518	60	2,760
Oysters	100	Tons	100	2,500	40	4,000
Potatoes	660	Barrels	58	2,900	40	2,320
Oranges	5,000	Boxes	250	15,000	40	10,000
Rice	35,700	Sacks	3,213	257,040	40	128,520
Salt	50	Tons	50	150	40	2,000
Shingles	200,000	Number	40	1,000	50	2,000
Wood, cord	160	Cords	160	640	30	4,800
Total			24,535	913,785		1,044,840

It will be noted that the tonnage for 1915 is less than that for 1914. This is accounted for by the damage to the cotton crop by the recent hurricane of August, 1915. The reduction in cotton traffic is especially marked in the lower portion of the river, where only 50 bales went out over the bar in 1915. During the year 1915 there was a big increase over 1914 in bricks, fur, lumber, and rice. Under normal conditions it is believed the total commerce would have increased during the year over that of 1914.

3. A survey of the important points in the Mermentau River was made during March, 1916. Maps[1] of the completed survey are submitted herewith, in five sheets. These sheets are briefly as follows:

Sheet No. 1. Entrance to Gulf of Mexico.
Sheet No. 2. Channel in Lower Mud Lake.
Sheet No. 3. Upper Mud Lake.
Sheet No. 4. Channel in lower end of Grand Lake.
Sheet No. 5. Channel in upper end of Grand Lake, and proposed enlargement of cut-off in Mermentau River above Grand Lake.

The soundings are referred to mean low gulf level.

4. *Description of surveys—Bar at entrance to Gulf of Mexico* (*sheet No. 1*).—The least depths found at the Gulf entrance and over the bar are 3 to 4 feet. Soundings were more or less difficult at this locality, due to rough water and surface currents.

To provide a channel 5 feet deep and 60 feet wide on bottom, with side slopes of 1 on 1 and with 1-foot overcut, would require about 5,100 linear feet of dredging, amounting to 19,000 cubic yards. There should also be placed about eight channel markers, of three piles each, yellow pine, 40 feet long. The estimated cost is as follows:

Dredging, 19,000 cubic yards, at 20 cents	$3,800
Eight channel markers (3-pile clusters) at $100	800
	4,600

5. *Channel in Lower Mud Lake* (*Sheet No. 2*).—There is an ample 5-foot channel, except for two shoals. The first shoal lies between

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[1] Not printed.

miles 3.78 and 4.11; the second between miles 5.06 and 5.29. The length of the first shoal is about 1,750 feet; the length of the second shoal is about 1,200 feet.

To provide a channel 5 feet deep and 60 feet wide on bottom, with side slopes of 1 on 1 and with 1-foot overcut, and to properly mark the same, is estimated to cost as follows:

Dredging, 12,000 cubic yards, at 20 cents	$2,400
19 channel markers (3-pile clusters), at $100	1,900
	4,300

6. *Upper Mud Lake* (*Sheet No. 3*).—In this lake a channel of ample depth and width was found. The main trouble is that there are no markings, and it is therefore very difficult to follow the channel, and not unusual for vessels frequently to get aground. The estimate for marking the channel in Upper Mud Lake is as follows:

23 channel markers (3-pile clusters), at $100	$2,300

No dredging is needed to secure a channel 5 by 60 feet.

7. *Channel in lower end of Grand Lake* (*Sheet No. 4*).—Survey was made to include 3 miles of the lower portion of the lake without finding 6 feet of water. Five-foot depth is about at point B, about 11,000 feet from the beginning of the lower Mermentau; the 4-foot depth is at point A, about 3,500 feet from the mouth of the river. The present depth over the bar at the lower end of the lake is about 3 feet.

To provide a channel 5 feet deep and 60 feet wide on bottom, with side slopes of 1 on 1 and with 1-foot overcut, for the distance from O to B, 11,000 linear feet, would involve the removal of 50,000 cubic yards of material, which at 20 cents a cubic yard would cost $10,000.

To provide a 5-foot channel from O to point A (3,500 linear feet), with a 1 foot overcut, would require the removal of about 21,000 cubic yards of material, which at 20 cents a cubic yard would cost $4,200. A 4-foot channel, O to A, with 1-foot overcut, will cost $2,300 for dredging.

Either channel would be difficult to maintain, but it is believed the maintenance would not be as expensive as placing a revetment and that some work should be undertaken at least to point A. There would be 11 channel markers, of three piles each, from O to B, costing $1,100, or four markers from O to A, costing $400.

8. *Channel in upper end of Grand Lake* (*Sheet No. 5*).—There is shoal water in the upper part of the lake, as indicated at C–D.

To provide a channel 5 feet deep and 60 feet wide on bottom, with side slopes of 1 on 1 and with 1-foot overcut, would require about 3,000 linear feet of dredging, involving about 12,000 cubic yards of material, which at 20 cents a cubic yard would cost $2,400. Five channel markers (3-pile clusters) should also be placed at a cost of $500.

9. On Sheet No. 5 is also shown the cut-off in Mermentau River, about 4 miles above Grand Lake. The cut-off is at present about 32 feet wide at the surface and 5 feet deep. There is a length of 280 feet between bank lines. The approaches to the cut-off are shoal. To enlarge this cut-off to a depth of 5 feet and a width of 60 feet on bottom, with 1 on 1 side slopes and 1-foot over-cut, and extend the dredging to the 5-foot contour, would involve about 1,150 linear fe

or about 11,000 cubic yards, which at a cost of 20 cents a cubic yard would amount to $2,200.

Channel markers of three-pile clusters should be driven on each end of the approach to mark the channel—two at the lower end and one at the upper end. The estimated cost of these markers is $300.

10.

Estimate for a channel 5 feet deep at mean low gulf, 60 feet wide on bottom, with side slopes of 1 on 1 and with 1-foot overcut.

RECAPITULATION.

Sheet No.	Section.	Length.	Material, at 20 cents.	Estimated cost.	Channel markers, $100 each.	Estimated cost.	Total.
		Feet.	*Cu. yds.*				
1	Bar at Gulf	5,100	19,000	$3,800	8	$800	$4,600
2	Lower Mud Lake	2,950	12,000	2,400	19	1,900	4,300
3	Upper Mud Lake	......	......	......	23	2,300	2,300
4	Lower Grand Lake	11,000	50,000	10,000	11	1,100	11,100
5	Upper Grand Lake	3,000	12,000	2,400	5	500	2,900
5a	Cut-off	1,150	11,000	2,200	3	300	2,500
		23,200	104,000	20,800	69	6,900	27,700

Contingencies	$2,300
Improvement, total cost	30,000
Maintenance, annual cost	3,000

The work should be done in two seasons, and the initial appropriation should be $15,000.

11. On account of the great length of channel to be dredged to secure 5-foot depth, it was thought wise to determine the cost of a 4-foot depth for the portion from lower Grand Lake to the mouth, simply as a comparison. This has been done, as follows:

Estimate for a channel 4 feet deep at mean low gulf and 60 feet wide on bottom, with side slopes of 1 on 1, for the Gulf entrance, Lower Mud Lake, Upper Mud Lake, and lower end of Grand Lake; and 5 feet deep and 60 feet wide on bottom for the upper end of Grand Lake and in cut-off:

Sheet No.	Section.	Length.	Depth.	Overcut of 1 foot.	Material, at 20 cents.	Estimated cost.	Channel markers, $100 each.	Estimated cost.	Total.
		Feet.	*Feet.*		*Cu. yds.*				
1	Bar at Gulf	400	4	No	1,000	$200	4	$400	$600
2	Lower Mud Lake	800	4	Yes	4,000	800	19	1,900	2,700
3	Upper Mud Lake	......	4	Yes	......	......	23	2,300	2,300
4	Lower Grand Lake	3,500	4	Yes	11,500	2,300	4	400	2,700
5	Upper Grand Lake	3,000	5	Yes	12,000	2,400	5	500	2,900
5a	Cut-off	1,200	5	Yes	11,000	2,200	3	300	2,500
		8,900	......	......	39,500	7,900	58	5,800	13,700

Contingencies	$1,300
Improvement, total cost	15,000
Maintenance, annual cost	1,800

The maintenance is proportionately higher, on account of the isolated locality and cost of getting plant to the work.

The work should be done in one season, and the entire amount of $15,000 should be appropriated in one sum.

12. *Estimate for 6-foot channel.*—A channel 6 feet deep and 60 feet wide, with 1-foot overdepth, is impracticable, owing to the large amount of yardage involved and to the length of exposed channel. To secure such a channel over the bar at mouth would require about 5,600 linear feet of dredging, involving 32,000 cubic yards; through Lower Mud Lake, about 6,000 linear feet, involving 25,000 cubic yards, through Upper Mud Lake, no dredging; through lower end of Grand Lake, at least 22,000 linear feet, involving 113,000 cubic yards; at upper end of Grand Lake, at least 8,000 linear feet, involving 36,000 cubic yards; and through the cut-off, 1,200 linear feet, involving 14,000 cubic yards; making a grand total of at least 42,800 linear feet, involving 220,000 cubic yards, or an expenditure of $44,000. The guide clusters and contingencies would increase this amount to $60,000.

Grand Lake is very shallow, and a 6-foot depth is found only at a considerable distance from the shore line. If it were desired to provide a 6-foot depth through the present traveled course, nearly all of the lake would require dredging, which would further greatly increase the estimate.

13. The present project, adopted in 1892 and as stated in report on preliminary examination, provides for securing the natural channel in river and tributaries by removing obstructions throughout the improvement, and for securing a suitable channel through Lower Mud Lake, with dikes, etc., at an estimated cost of $23,615.25. In 1897 dredging was approved to supplement dikes in Lower Mud Lake. No approved estimate of cost of maintenance, nor channel dimensions or limits of improvement, were stated. The tributary included in the present project is the Nezpique, for a distance of 25 miles. No work has been done on that stream, except occasional snagging, the general depths being in excess of 6 feet.

In regard to the scope and work under the present project, the following is submitted:

The report dated August 13, 1891, found on page 1862 of the Annual Report of the Chief of Engineers for 1891, gives the scope of the improvement, which provided for securing the natural channel by removing snags and by the construction of two brush dams in Lower Mud Lake.

On page 1498 of the Annual Report of the Chief of Engineers for 1898 it is stated that the project approved June 15, 1897, provides for dredging and for the construction of brush dams. At the time of the original survey, the depth of water on the bar was 5 feet and the depth in the river was 13 feet. The original estimate of $23,615.25 did not include any work on the bar, the estimate for this latter item alone being $781,210 for the construction of a single jetty 11,140 feet in length.

On page 1478 of the Annual Report of the Chief of Engineers for 1898 the project is stated as consisting in dredging and the construction of brush dams to secure a channel through Mud Lake 50 feet wide and 6 feet deep, and that a contract under this project was begun late in 1897 and finished in 1898, producing an average depth on the bars at Lower Mud Lake of 8 feet and an average width of 50 feet.

On page 2264 of the Annual Report of the Chief of Engineers for 1900 it is stated that redredging Lower Mud Lake was done under contract commenced November 6, 1898, the work being done during November–December of 1899, completing a channel 6½ feet deep.

On page 1902 of the Annual Report for 1901 it is stated that the brush dams in Lower Mud Lake were damaged by storms and settlement, and did not effectively confine the current, and that the channel depth was then 5 feet.

It appears from the above records that the project depth, while not stated, was expected to be at least 6 feet at Lower Mud Lake and that the depth of 5 feet over the bar ought not be increased at that time.

14. The expenditures during the last six years have amounted to $5,108.82; and have been made for part payment of dredge, dredging, surveys, supervision, snagging in Bayou Nezpique, and for snagging in Bayou des Cannes as a tributary, for which last item the sum of $500 was allotted.

Up to June 30, 1916, $26,115.25 has been expended for improvement and $12,759.88 for maintenance, a total of $38,875.13. The balance available (June 30, 1916) is $3,267.92.

15. The estimate for a channel 6 feet deep is impracticable. The alternate estimate indicated in paragraph 11 is not recommended, as any depth less than 5 feet is not considered advisable as a project. The project for a 5 by 60 foot channel, as outlined in paragraph 10, while entailing considerable dredging over long stretches, is nevertheless justified, and the actual prosecution for the present might be limited to the most important portions. The estimate of $3,000 for maintenance will not allow dredging the whole distance each year, but will allow work over the most important shoals and, by accumulating the yearly maintenance, it will allow dredging over the whole portion every two or three years.

16. Grand Lake will form a link in the proposed intracoastal waterway from Franklin to Mermentau, the project depth for which is 5 feet, and it also connects with the other navigable tributaries of the upper Mermentau River, where the depths are 5 feet or greater. After the completion of the intracoastal waterway, the necessity of keeping open the channel over the bar and through Lower Mud Lake will be not so vital, though still necessary, as the distance from Grand Chenier to Port Arthur by the Gulf will be some 40 miles shorter than via the intracoastal waterway route. For these reasons, the full project, for a channel 5 feet deep and 60 feet wide throughout is favored, though the immediate prosecution might be limited at first to the marking of the channels and the dredging of the most important portions.

17. The entire stream below Lake Arthur is without any railroad service, and the people along the lower portion are absolutely dependent on water transportation. It is further firmly believed that the commerce of the lower portion of the Mermentau will increase as the lands are drained and developed and as the population and products become greater, especially in view of the fact that no railroad facilities can be expected for many years.

18. The locality is considered worthy of improvement, and it is recommended that the project for the stream be stated as follows:

> Improving Mermentau River, by removing obstructions and by dredging and placing guide marks, to provide a channel 5 feet deep at mean low gulf and 60 feet wide at bottom, from the mouth to the junction of Bayous des Cannes and Nezpique, at an estimated cost of $30,000 and $3,000 annually for maintenance.

EDWARD H. SCHULZ,
Major, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER,
GULF DIVISION,
New Orleans, La., August 4, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded, concurring in the recommendations of the district officer.

J. C. SANFORD,
Colonel, Corps of Engineers, Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors on survey, see p. 3.]

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64TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 1763.

MOBILE HARBOR, ALA.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATION AND SURVEY OF MOBILE HARBOR AND BAR, ALA., WITH A VIEW TO SECURING SUCH ADDITIONAL DEPTH AND WIDTH OF CHANNEL AS THE INTERESTS OF COMMERCE MAY REQUIRE.

DECEMBER 18, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

WAR DEPARTMENT,
Washington, December 16, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated September 16, 1916, together with copies of reports from Lieut. Col. C. A. F. Flagler, Corps of Engineers, dated May 21, 1913, and Lieut. Col. C. Keller, Corps of Engineers, dated December 11, 1915, with maps, on a preliminary examination and survey, respectively, of Mobile Harbor and Bar., Ala., made by them in compliance with the provisions of the river and harbor act approved March 4, 1913.

Very respectfully,

NEWTON D. BAKER,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, September 16, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Mobile Harbor, Ala.

1. There are submitted herewith for transmission to Congress report dated May 21, 1913, by Lieut. Col. C. A. F. Flagler, Corps of

Engineers, and report dated December 11, 1915, with maps, by Lieut. Col. C. Keller, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the river and harbor act approved March 4, 1913, of Mobile Harbor and Bar, Ala., with a view to securing such additional depth and width of channel as the interests of commerce may require.

2. Mobile Harbor ship channel extends from Chickasaw Creek to deep water in lower Mobile Bay, a distance of about 33½ miles. From the lower end of this channel to Mobile Bar, a distance of about 6 miles, there is a natural depth of 30 feet or more, with a width of from 1,000 feet to more than 2,500 feet. The existing project for improvement of Mobile Harbor, adopted by the river and harbor act of June 25, 1910, provides for a channel 27 feet deep at mean low water, 300 feet wide in Mobile River and 200 feet wide in Mobile Bay. To June 30, 1915, the total expenditures on all projects for the harbor amounted to $7,322,362.33. The existing and only project for improvement of Mobile Bar was adopted by the act of June 13, 1902, and provides for a channel 300 feet wide and 30 feet deep at mean low water. Expenditures on this project to June 30, 1915, amounted to $241,739.20. All original work at the harbor and bar has been completed, and present operations consist of maintenance. The district officer submits estimates for channels in Mobile Harbor 27 feet and 30 feet deep and 300 feet wide, both by way of the present route and by way of a new route along the western side of the bay. Estimates are also submitted for channels 33 and 35 feet deep and 450 feet wide over the bar. He believes that a channel across the bar 33 feet deep and 450 feet wide, at an estimated cost of $62,200, and a channel in the bay and river in the present location 30 feet deep and 300 feet wide at the bottom, at an estimated cost of $1,030,000, are justified by the extent of the commercial interests involved, and he recommends that channels of these dimensions be adopted, provided that no work be done until local authorities have made provision for the establishment of additional transfer and terminal facilities. It is proposed to do the work by existing Government plant, augmented by one additional dredge, the cost of which is included in the above estimate for the channel in Mobile Bay and River. The division engineer concurs in the recommendations of the district officer.

3. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated August 8, 1916, concurring in the views of the district officer and division engineer, with a slight modification of the recommended conditions of local cooperation.

4. After due consideration of the above-mentioned reports, I concur generally in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Mobile Harbor and Bar, Ala., is deemed advisable to the extent of providing a channel over the bar 450 feet wide and 33 feet deep at mean low water, as proposed by the district officer, at an estimated cost of $62,200 and $15,000 annually for maintenance; and a channel in the bay and river 300 feet wide and 30 feet deep at mean low water, following the present location, at an estimated cost of $1,030,000 and

$150,000 annually for maintenance; provided that no work be done under the new project until local interests have established pilotage dues and port regulations satisfactory to the Secretary of War, have submitted acceptable plans for development of adequate terminal facilities, and have given assurance satisfactory to the Secretary of War, that these terminal facilities will be provided within a reasonable time. The first appropriation should be $850,000, and subsequent appropriations, including the amounts required for maintenance, should be so made as to complete the work in four years.

W. M. BLACK,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
August 8, 1916.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following is in review of the district officer's reports authorized by the river and harbor act of March 4, 1913, on preliminary examination and survey of Mobile Harbor and Bar, Ala., with a view to securing such additional depth and width of channel as the interests of commerce may require.

2. Mobile Harbor channel extends from deep water in lower Mobile Bay to the mouth of Chickasaw Creek in Mobile River, a distance of about 33½ miles. The bar channel connects deep water in the lower bay with that in the Gulf of Mexico. Between the southern end of the harbor channel and bar channel, a distance of about 6 miles, the natural depth is in excess of 30 feet.

3. The existing project for the bar, adopted by the river and harbor act of June 13, 1902, provides for a channel 300 feet wide and 30 feet deep at mean low water at an estimated cost of $100,000 and $20,000 annually for maintenance. The project was completed in 1914. The total amount expended on the bar project to June 30, 1915, was $241,739.20, of which $141,739.20 was for maintenance. The existing project for the Mobile Harbor channel, adopted by the river and harbor act of June 25, 1910, provides for a channel 27 feet deep at mean low water, 300 feet wide in the river and 200 feet wide in the bay, at an estimated cost of $1,802,548 and $100,000 annually for maintenance. The project has been completed at a total cost to June 30, 1915, of $1,776,871.15, of which $297,744.45 was for maintenance. The total expenditures on all projects have been $7,322,362.33.

4. During the past three years the commerce passing through these channels, not including the steamboat and barge commerce from the river system above Mobile, has averaged about 1,629,000 tons, having a value of about $51,000,000. The vessels available for this traffic, which is largely export, have been increasing in size, and it is now reported that the channel facilities are inadequate. In the study of this subject consideration has been given to a change in the location of the bay channel from its present position, near the center of the

bay to near the western shore, and of the bar channel to a position slightly west of the present location, with a view in both cases to possible economy in future maintenance.

5. Estimates have been prepared as follows:

BAR CHANNEL.

	35-foot depth.			33-foot depth.		
	Width.	By contract.	By hired labor.	By contract.	By hired labor.	Maintenance
	Feet.					
Present location................	450	$93,800	$56,300	$45,800	$27,500	$15,000
New location................	450	150,900	90,600	93,600	62,200	15,000

BAY CHANNEL.

	Depth.	Width.	By contract.	By hired labor.	Maintenance.
	Feet.	*Feet.*			
Present location..........................	27	300	$965,000	$515,000	$100,000
Do..........................	30	300	1,345,000	1,030,000	150,000
Near western shore..........................	30	300	4,515,000	3,610,000	191,000

6. The district officer believes that additional facilities should be given and that for the present and immediate future a channel across the bar 33 feet deep and 450 feet wide and a channel in the bay and river 30 feet deep and 300 feet wide will meet the requirements of navigation and are justified by the commercial interests involved. He recommends improvement to this extent, the work to be done by hired labor and Government-owned plant, at an estimated cost for the bar channel of $62,200 and $15,000 annually for maintenance, and for the bay-river channel of $1,030,000 and $150,000 annually for maintenance, the bar channel to follow the new location a short distance to the west and the bay channel to remain in its present location. He recommends further that no work be done until local interests have presented satisfactory plans for additional terminal facilities and given assurance that they will be carried to completion at a suitable rate of progress. The division engineer concurs in the views and recommendations of the district officer.

7. In connection with its consideration of this subject, the board gave a hearing at its office in Washington on July 25, 1916, at which statements and arguments bearing upon the advisability of additional improvement were presented. It appears from the information now available that existing channel facilities do not fully meet the economic requirements of this port. Vessels of greater draft than can now safely enter the harbor are available in the Gulf trade and would be used to the advantage of general commerce and navigation if the increased depth now desired were given. The commerce of the port is large and valuable and any additional advantages given in the way of increased port facilities will be felt throughout the extensive territory commercially tributary, and it is believed that the benefits to be anticipated from the improvement proposed are sufficient to warrant the expenditure involved.

8. In view of what precedes, the board concurs with the district officer and the division engineer and recommends a modification of

the existing project so as to provide for a channel over the bar 450 feet wide and 33 feet deep at mean low water, following the new location proposed, at an estimated cost of $62,200 and $15,000 annually for maintenance, and a channel in the bay and river 300 feet wide and 30 feet deep at mean low water, following the present location, at an estimated cost of $1,030,000 and $150,000 annually for maintenance; provided, however, that no work be done under the new project until local interests have established pilotage dues and port regulations satisfactory to the Secretary of War, have submitted acceptable plans for development of adequate terminal facilities, and have given assurance satisfactory to the Secretary of War that these terminal facilities will be provided within a reasonable time. The first appropriation should be $850,000, and subsequent appropriations, including the amounts required for maintenance, should be so made as to complete the work in four years.

9. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects so related to the project proposed that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interests of navigation.

For the board:

Frederic V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF MOBILE HARBOR, ALA.

United States Engineer Office,
Mobile, Ala., May 21, 1913.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Preliminary examination of Mobile Harbor and Bar, Ala.

1. In compliance with directions contained in department letter dated March 18, 1913, the following report is submitted of a preliminary examination of Mobile Harbor and Bar, Ala., with a view to securing such additional depth and width of channel as the interests of commerce may require.

2. *Previous examinations and surveys.*—Reports of examinations and surveys of these localities are printed in annual reports of the Chief of Engineers and House documents, as follows:

Report for 1827, survey.
Report for 1853, examination.
Report for 1871, examination.
Report for 1873, page 693, survey.
Report for 1879, pages 100 and 779, examination and survey.
Report for 1880, page 1052, survey.
Report for 1885, page 1338, survey.
Report for 1885, page 1885, examination.
Report for 1896, page 1463, survey.
Report for 1901, page 1854, survey.
House Document No. 647, Fifty-ninth Congress, first session, survey.
House Document No. 657, Sixty-first Congress, first session, examination and survey.

3. *Geographical location and physical characteristics.*—The Mobile Harbor ship channel is about 33½ miles long and extends from 4.8 miles above the mouth of Mobile River to deep water in lower Mobile Bay. The channel across Mobile Bar connects deep water in the lower bay with that in the Gulf of Mexico. The total distance from the upper end of the dredged channel to the 40-foot curve of depth in the Gulf of Mexico is about 40½ miles. Mobile Bay, through which the dredged channel extends, has an area of about 394 square miles. It is an arm of the Gulf of Mexico and is connected with Mississippi Sound by a shoal waterway between the mainland of Alabama and Dauphin Island. There is in this waterway a navigable depth of 6 feet through one of the several passes. The depth over Mobile Bar before any dredging was done was 23 feet. There is at present a depth of 27 feet, and this is being increased to 30 feet over a width of 300 feet, the project dimensions, by the U. S. dredge *Charleston.* It is believed that this will be accomplished within the next two months. There is a natural depth of 300 feet or more from the outer bar to a point just south of beacon M–G, in the lower bay, a distance of about 6 miles. The lower part of Mobile Bay contains a natural depth sufficient to float the largest vessel yet built. Above the deep water at the lower end of Mobile Bay the natural depth along the line of deepest water outside of the dredged channel gradually decreases from 17 feet just north of the deep water to 5 feet near the mouth of Mobile River.

The present project was adopted by the river and harbor act of June 25, 1910, and provides for the formation of a channel 200 feet wide in Mobile Bay and 300 feet wide in the river with a turning basin 600 feet by 800 feet at the upper end, the depth throughout to be 27 feet at mean low tide, at an estimated cost of $1,802,548. In Mobile River the channel has been dredged to the projected depth and from 160 to 300 feet wide. With funds appropriated by the river and harbor act of March 4, 1913, the channel in the river will be completed to project dimensions. The channel in Mobile Bay will have been dredged to its full project dimensions upon completion of the contract now in force, which will expire August 21, 1913, and it is believed by this time or soon thereafter the U. S. dredge *Wahalak* will have removed the greater portion of the shoaling that has occurred. Except at two localities where small shoals exist there is a continuous shoal over that portion of the channel below beacon M–B–A. In some places there is only a depth of 23 feet, but the material consists largely of a very soft soup-like mixture that can be barely felt by means of a delicate lead line.

4. *Work under present project.*—Up to April 1, 1913, there had been removed under the present project from the Mobile Harbor ship channel by contract and Government dredges, 16,959,162 cubic yards of material, place measurement. In order to complete the project there yet remains to be removed 2,375,623 cubic yards of material, 1,432,000 cubic yards of which will be dredged from the channel in Mobile Bay under present contract. At the present time the maintenance work to be done in order to clear the channel of shoals amounts to about 2,300,000 cubic yards. This will be done by

the U. S. dredge *Wahalak*, and as the material is very soft it is believed that she will remove it in about four or five months. The amounts appropriated and expended on the present project to April 1, 1913, exclusive of the amounts spent for removing sunken obstructions, are as follows:

Appropriated:	
July 1, 1910, balance unexpended	$72,785.12
Appropriated June 25, 1910	450,000.00
Appropriated Feb. 27, 1911	500,000.00
Appropriated July 25, 1912	400,000.00
Appropriated Mar. 4, 1913	250,000.00
Received from sales during this time	199.25
Total	1,672,984.37
Expended (original work):	
Fiscal year ending June 30, 1911	321,322.86
Fiscal year ending June 30, 1912	496,599.64
From July 1, 1912, to Mar. 31, 1913	385,177.91
Total	1,203,100.41

The unexpended balance is sufficient to complete the project and to maintain it during the fiscal year 1914.

The project for dredging a channel 300 feet wide and 30 feet deep across Mobile bar was adopted by the river and harbor act of June 13, 1902. Up to April 1, 1913, there had been expended $200,082.43 on this work, the sum of $98,000 of which was expended for original work and the balance for maintenance. The movement of sand on this bar is from east to west, and consequently the shoal to the east is gradually moving to the west. On this account the shoaling in the channel averaging 28,000 cubic yards per year from 1903 to 1906 increased to 156,000 cubic yards per annum in 1908, and continued to increase until the channel was recently shifted about 600 feet west of the position it then occupied. A large amount of maintenance work will eventually have to be done if the channel is kept in one position. On April 1, 1913, it was estimated that the completion of the outer bar channel to project dimensions would require the removal of 72,338 cubic yards.

5. *Watershed, resources, industries, and commerce.*—Mobile Bay and the streams emptying into it drain about three-fifths of the State of Alabama and portions of the States of Mississippi and Georgia, comprising in all an area of about 44,700 square miles. The Alabama and Tombigbee Rivers unite to form the Mobile River, and, together with their tributaries, run through some of the richest farming and mining sections in the United States. One lock has been constructed and 3 others are being constructed along the lower Tombigbee River, and 12 have been practically completed, and one is under construction on the Black Warrior River. When these locks are completed a low-water draft of 6 feet can be carried from Mobile to the coal and iron fields west of Birmingham, a distance above Mobile of 441 miles up the Mulberry Fork of the Black Warrior River, and 421 miles up the Locust Fork of this river.

The upper Tombigbee River, which unites with the Black Warrior just above Demopolis, Ala., to form the lower Tombigbee River, is open to steamboat navigation throughout the year up as far as Columbus, Miss., 379 miles above Mobile, except during the period of low water and is actually navigated by regular packet steamers out of Mobile during the winter and spring seasons. This section of the river is bordered by some of the richest farming land in the United States. It flows through what is known as the "black belt," where it was estimated a few years ago that about one-fifteenth of the cotton produced in the United States is raised.

The Alabama River is under improvement by the Federal Government as far up as Wetumpka, about 10 miles above the mouth of the Coosa River, about 29 miles above Montgomery, and 432 miles above Mobile. Packet steamers out of Mobile make regular trips all the year on this river as far up as Montgomery. The Coosa River is a branch of the Alabama River and penetrates into Georgia. Two hundred and eleven miles of this river are under improvement. Several locks have been constructed. Large quantities of farm and timber products and general merchandise are carried on the Alabama River.

It will be seen from the foregoing that there is a network of streams connecting Mobile Harbor with a large area of country rich in farm and timber products, coal and iron mines—a country that is as yet in the infancy of its development.

The deep-water commerce of Mobile Harbor, incoming and outgoing, during the calendar year 1912, amounted to 1,521,637 tons, valued at $52,823,370, divided as follows:

Articles.	Amount in short tons.	Valuation.	Articles.	Amount in short tons.	Valuation.
Asphalt	24,440	$153,326	Lumber and timber	698,832	$7,173,228
Bananas	149,312	2,063,618	Manufactured goods	11,766	1,270,839
Breadstuffs	61,019	2,992,407	Naval stores	34,470	1,669,882
Coal	3,900	23,250	Oil	19,693	708,975
Cotton and cotton products	76,226	16,905,308	Potash	4,656	146,708
Coconuts	2,837	86,937	Pineapples	825	164,844
Fish and oysters	15,848	198,000	Staves	77,331	763,045
Hay and grain	87,534	1,134,179	Sisal grass	17,832	1,819,404
Hog products	11,872	2,505,013	Sugar	313	31,308
Hardwoods	27,132	250,028	Miscellaneous	161,897	12,373,675
Iron pyrites	52,942	179,521			
Kainit	30,750	146,687	Total	1,521,637	52,823,370
Live stock	210	63,138			

Average haul and rate per ton-mile could not be obtained. In addition to the above, water shipments to and from the Alabama, Tombigbee, and Mobile Rivers, consisting of cotton, cotton goods, cotton seed, cottonseed meal, fertilizers, logs, feed, provisions, machinery, farm supplies, and manufactured goods amounted in 1912 to about 518,721 tons, valued at $10,201,016. Bunker coal was furnished, in addition to the above, to outward-bound steamships and tugs amounting to 170,128 tons, valued at $469,226.

The following lines of steamships operate between Mobile and foreign ports:

United Fruit Co., Orr-Laubenheimer Steamship Co., Camors-McConnell Steamship Co., and Hubbard-Zemurry Steamship Co., Central American ports.

Atlantic & Mexican Gulf Steamship Co., Mexican ports.
Munson Line, Cuban ports.
Elder-Dempster Co., Leyland Line, Lamport and Holt Line, Harrison Line, Manchester Line, Mobile & Atlantic Steamship Co., and Gulf Shipping Co., United Kingdom and Continent.
Seeberg Steamship Line, Windward Islands.
United States Shipping Co., Cuban and Central American ports.

The following lines of steamships operate between Mobile and coastwise ports:

Mallory Line, Tampa, Fla., Brunswick, Ga., and New York.
Pensacola, St. Andrews, and Gulf Steamship Co., Florida ports.

A comparison of the tonnage and value of the commerce, including bunker coal and the river traffic, for the past 11 years, as shown in annual reports of the Chief of Engineers, and statement of tonnage above, is as follows:

For year ending Dec. 31—	Tons.	Value.	For year ending Dec. 31—	Tons.	Value.
1902	1,746,219	$29,565,526	1908	2,129,801	$50,434,973
1903	1,899,738	44,662,750	1909	2,141,742	58,289,593
1904	1,989,388	50,142,187	1910	2,183,840	61,844,716
1905	2,785,213	63,197,160	1911	2,203,712	59,027,974
1906	2,593,563	58,806,893	1912	2,210,486	63,493,612
1907	3,304,998	61,241,807			

There has been a considerable increase in commerce during the past year, due to the increase in foreign trade.

Following is a comparative statement of the number of vessels drawing 20 feet or more that departed from Mobile during the past 11 years:

Draft.	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
20 to 21 feet	43	26	38	61	64	53	56	58	51	50	47
21 to 22 feet	33	45	27	49	34	52	34	41	36	40	43
22 to 23 feet	19	23	35	30	8	......	15	39	43	47	70
Total	95	94	100	140	106	105	105	138	130	137	160

It will be seen from the above that there has been a large increase in the number of deep-draft vessels using the channel during 1912.

The records of the harbor master and shippers indicate that vessels are continually departing loaded to a draft equal to the mean low-water depth of the channel. Many would take on considerably more cargo if the available depth permitted. There is submitted below a list of vessels controlled by two of the principal local agents that visited this port in 1912. As 23 feet was the available depth, it is apparent that a considerable number of these vessels could have taken on more cargo had the depths in the channel permitted.

VESSELS CONTROLLED BY MOBILE LINERS (INC.).

Name.	Net register tonnage.	Loaded draft.		Length.		Beam.	
		Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Corinth	2,369.57	21	11½	346.5	0	50.8	0
Crown of Cordova	2,238.85	22	3	345	0	46	2
Cayo Romano	2,326	24	4	354	0	48	0
Hazlewood	1,992	22	6	325	0	48	0
Almerian[1]	1,875	22	3	351	5	42	3
Albanian[2]	1,875	22	3	351	5	42	3
Canto	2,392.62	22	2½	348	0	50	2½
Mercian	4,060	24	6	400	0	52	0
Corby	2,279.74	23.2	0	331	0	48	0
Wm. Cliff	2,209.26	23	0	370	0	41	2
Vogesen	2,357	22	0	349.2	0	51	0
Vesterland	2,331	....		347	0	50	0
Caledonia	1,144	....		278.6	0	40.4	0
Alexandrian	2,899	27	0	411	0	46.7	0
Student	2,303.81	25	1½	350	0	45	10
Median	4,067	24	6	400	0	52	0
Nubian	4,012	29	4½	400	0	52.4	6
Dorisbrook	1,814	22	6	320.1	0	46.1	0
Iriston	2,398	22	5	354.3	0	51.1	0
Glendene	2,428	22	4	350	0	51.1	0
Melford Hall[2]	3,506	26	4	411	0	53.5	0
Kyleakin	1,976	21	0	331	0	48	0
Manchester Citizen	2,726	....		380.1	0	49	6
Nitonian	4,012	29	4½	400	0	52.4	0
Cuban	2,728.13	25	4	360	0	43	6

[1] This boat made 4 trips during the year.

[2] These boats made 2 trips during the year.

VESSELS CONTROLLED BY ELDER-DEMPSTER LINE AGENCY.

Name.	Net register tonnage.	Loaded draft.	Length.	Beam.
		Feet.	*Feet.*	*Feet.*
Konakry[1]	2,334	25.8	360	53
Italian Prince	1,998	23.8	339	42
Norman Prince[2]	2,235	23.2	353	45
Ravn	795	....	241	36
Memnon	2,046	24.1	392	49
Kwarra	2,304	25.6	360	52
Ernesto	1,691	23.4	320	39
Ramon de Larrinaga	1,983	24.6	350	40
Cayo Soto	1,988	22.1	231	45
Clifton	2,313	24.6	340	47
St. Andrews	2,334	21.9	347	51
Castano[1]	2,502	25.4	350	48
Black Prince	2,560	24.3	345	50
Cayo Citano	1,983	22.1	331	45
Swedish Prince	2,378	22.0	356	49
Saxon Prince	2,236	23.2	353	45
Dacre Hill[2]	1,714	20.4	314	46
Corby	2,280	23.2	331	48
Ethiope[2]	2,475	24.6	340	47
Aboukir	2,345	22.7	352	50
Madrileno	1,778	24.7	328	42
Inkula	3,313	27.6	401	52
Talisman	1,178	....	270	39
British Monarch	2,547	23.2	345	50
Copenhagen	2,910	23.11	385	52
Hubert	2,331	24.0	355	49
Tudor Prince	2,767	24.11	360	48
Saba	2,687	23.1	370	50
Amakura	1,497	19.1	291	39
Norfolk	2,349	22.9	344	49
Largo Law	2,541	26.0	380	50
Horncap	2,127	21.6	341	40
Drumcraig	2,936	24.7	410	52
Salybia	2,131	23.4	342	46
Drumlanrig	2,763	24.3	385	50

[1] These boats made 3 trips during the year.

[2] These boats made 2 trips during the year.

The following railroads run into Mobile, it being a terminus of the first five roads: The Mobile & Ohio; the Southern; the New Orleans, Mobile & Chicago; the Bay Shore division of the Mobile & Ohio; the Alabama, Tennessee & Northern; and the Louisville & Nashville. A new road, the Pensacola, Mobile & New Orleans Railroad, is being constructed, and now extends from Pensacola to the eastern shore of Mobile Bay. Pending its further extension, arrangements are making for moving cars on barges across the head of the bay to Mobile.

6. *Terminal and transfer facilities, water-power development, etc.*—The city of Mobile owns about 1,800 feet of improved wharfage, extending from Dauphin to St. Anthony Streets, and the same facilities are extended to all on equal terms. Shipments can be delivered direct from wharf to vessel, as there is a depth of 23 feet alongside the wharf. Seagoing vessels usually load themselves by means of a steam power, but the river and packet boats are loaded and unloaded by hand.

Extensive terminal facilities are held by individuals and corporations. The railroads running parallel to the river front, generally at a short distance from it, control a large extent of frontage, and at the same time furnish by switches means of placing cars at the ship's side. Freight is handled from cars to ship, or vice versa, by hand or by steam furnished by the vessel. Bananas are usually handled by means of electric conveyers.

In some cases terminal and transfer facilities are extended to all on equal terms; in some cases they are not. There is a large amount of space available for public wharves, practically the entire eastern side of the river being undeveloped. For a detailed report on this subject attention is respectfully invited to report made by this office to the Chief of Engineers, dated January 20, 1913. The terminal facilities seem to be adequate at present and will probably be increased with the increase of shipping, but to guard against a monopoly in this direction it is believed that the railroads should be required to provide at an equitable rate switching and transfer service to all on equal terms, and that the city of Mobile should purchase property upon which wharves may be constructed as needed. In the local press of May 20, 1913, a news item indicates that this action has been secured through the Interstate Commerce Commission.

The question of water-power development, floods, and land reclamation do not enter into the improvement of Mobile Harbor, as the variation in water level is small and would not be affected by the desired improvement.

A public hearing was held by me in Mobile on May 9, 1913, record[1] of which is attached hereto.

The universally expressed desire of the commercial interests of Mobile is for increased width and depth of the channels in the river, in the bay, and across the bar. The 27-foot depth nearly attained on the present project has been of great value to the shipping interests, and every foot obtained is promptly taken advantage of. The demands for greater depth are based on:

1. The greater prevailing draft of the modern freight steamer. Many now use this port that could load to a greater depth if the

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[1] Not printed.

channel permitted, and many refuse charters to Mobile on account of the loss due to partial loading.

2. The sale of bunker coal to vessels. Mobile is a coal port; excellent steam coal can now be supplied here to all vessels at fair prices, and with the opening of the waterway to the Warrior coal fields in the next two years an enormous supply will be available at greatly reduced prices. Due to lack of depth, but few vessels will now take on coal at Mobile sufficient to cross the Atlantic. The practice is to take only what is needed to reach Norfolk, Va., and there fill the bunkers for the transocean voyage. This practice permits the carrying of a greater amount of freight, but entails loss of time, with consequent expense to the shipper, and robs Mobile of the opportunity to sell one of her most profitable commodities.

3. The desire to enter the same class with the other principal coast ports. It is represented that as long as Mobile has but 27 feet, while Pensacola, New Orleans, and Galveston have 30 or more, the idea will prevail that Mobile is a second-rate port. This desire is not sentimental only, for there is no doubt that many opportunities of developing the commerce of Mobile are lost simply because shipping capital when inaugurating new enterprises overlooks Mobile, due to its inferiority in depth as compared with other ports.

Increased width is asked in the river to obviate the necessity for private wharf owners dredging out to the project channel of 300 feet. This channel is ample for navigation, and in my opinion no increase is needed. The riparian owners can well afford to maintain the depth out to the channel on their own fronts, and many are now doing it.

In the bay the present channel is doubtless too narrow for convenience, safety, and to provide a margin for shoaling. In the report on which the present project is based, the district officer recommended 250 feet width and the division engineer recommended 300 feet. The Board of Engineers for Rivers and Harbors recommended 200 feet, which was adopted. It is not proving satisfactory, and greater width should be provided.

On the outer bar the district officer recommended a width of 600 feet and a depth of 33 feet. This was concurred in by the division engineer, but the Board of Engineers for Rivers and Harbors stated "that it will not be advisable to provide increased dimensions, at least until the work on Mobile Harbor Channel has advanced sufficiently to demonstrate the need of further improvement over the bar." I am convinced that the bar channel is too narrow and shallow for the present commerce, due to its hard bottom and frequent heavy seas, endangering vessels of a draft perfectly safe in the bay, and to the difficulties encountered by vessels passing each other in heavy weather in the present width of 300 feet. A maintenance dredge is usually working in the bar channel and necessarily incommodes traffic in a narrow channel. A further reason for greater width is the provision of a margin for shoaling which is rapid and irregular.

In conclusion I believe that the commercial needs of Mobile and the large commerce of the port justify an increase in depth throughout the project and an increase in channel width on the bar and in the bay. The amount of increase will necessarily be governed by the cost, and I recommend that a survey be made of the outer bar and of certain portions of the bay to permit the preparation of estimates on which to base definite recommendations.

C. A. F. FLAGLER,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
Baltimore, Md., May 29, 1913.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded, concurring in the recommendation of the district officer that a survey be made of the outer bar and of such portions of the bay as may be necessary to permit the preparation of estimates on which to base definite recommendations concerning future recommendations.

LANSING H. BEACH,
Colonel, Corps of Engineers,
Division Engineer.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
July 1, 1913.

The CHIEF OF ENGINEERS, UNITED STATES ARMY:

For reasons stated herein, the board concurs with the district officer and the division engineer in recommending a survey in order to determine the extent and advisability of the improvement. It requests special investigation as to the probable cost of maintenance.

For the board:

W. M. BLACK,
Colonel, Corps of Engineers,
Senior Member of the Board.

SURVEY OF MOBILE HARBOR, ALA.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., December 11, 1915.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Report on survey of Mobile Harbor.

1. The act of Congress approved March 4, 1913, contained a provision for a preliminary examination and survey, as follows:

> Mobile Harbor and Bar, Ala., with a view to securing such additional depth and width of channel as the interests of commerce may require.

2. The duty of making the preliminary examination was assigned to this office in department letter dated March 18, 1913, and the report was submitted by my predecessor on May 21, 1913. In this report he stated that, in his opinion, "the commercial needs of Mobile and the large commerce of the port justify an increase in depth throughout the project, and an increase in channel width on the bar and in the bay," and he recommended the making of certain surveys to permit the preparation of estimates.

3. The recommendations of the district officer were concurred in by the division engineer and the Board of Engineers on Rivers and

Harbors, and the survey was duly authorized by the Chief of Engineers in letter of July 7, 1913, in which directions were given that the report on the survey should contain: (*a*) A further expression of opinion as to the extent of justifiable improvements; (*b*) a statement as to the rate at which the work should be prosecuted and the amount of the initial appropriation. The Board of Engineers for Rivers and Harbors in its indorsement upon the report on the preliminary examination requested that special investigation be made as to the probable cost of maintenance of an enlarged channel.

4. The survey and such further investigation as then appeared to be necessary were completed in December, 1913, and a report was submitted on January 23, 1914; that is, some 8 months before the completion of the now authorized 27-foot channel. The division engineer, in forwarding this report to the Chief of Engineers, discussed the uncertainties of the estimate of the first cost and of the amount of deterioration of an enlarged channel, and suggested that the report be returned to the district officer with instructions to consider the advisability of substituting for a deep channel in the present location a canal or inclosed channel along the west side of Mobile Bay, and that additional surveys and observations be made to determine the size and position of the spoil banks at the side of the present channel, and, if possible, the changes which have occurred in them since first they were formed, in order, it was hoped, to afford some evidence whether, due to wave and tidal action, the material of the spoil banks helped to fill the dredged channel, and whether, by their mere weight, these banks injured the channel by squeezing or shoving soft material and causing it to flow into the cut. On February 21, 1914, the original report was returned to this office by the Chief of Engineers for the further investigations recommended by the division engineer. In compliance with instructions, the earlier report has been amended so as to include the additional information thus acquired.

5. The results of the surveys are shown in three sheets of maps and 6 sheets of cross sections, which are forwarded herewith, as follows:[1]

Plate No. I, map of Mobile Bar, Ala., 1913–1915.
Plate No. II, map of Mobile Bar, Ala., showing 30-foot contours, 1850–1915.
Plate No. III, map showing location of proposed channel, Mobile Bay, Ala.
Plate No. IV, cross sections, Mobile Harbor, Ala., beacon 16 to beacon 14.
Plate No. V, cross sections, Mobile Harbor, Ala., beacon 12–A to beacon 10–A.
Plate No. VI, cross sections, Mobile Harbor, Ala., beacon 10–A to beacon 8–A.
Plate No. VII, cross sections, Mobile Harbor, Ala., beacon 8 to beacon 6.
Plate No. VIII, cross sections, Mobile Harbor, Ala., beacon 4–A to beacon 2–A.
Plate No. IX, cross sections, Mobile Harbor, Ala., beacon 2 to beacon M–G.
Plate No. X, terminal facilities at Mobile, Ala.

6. The entire locality covered by the present survey is affected by the tide. Generally there are only one high and one low water during each 24 hours. The range of the tide is small, averaging only 1.4 feet in upper Mobile Bay and 1.1 feet in the lower bay. The currents are therefore feeble and uncertain, especially in the upper end of Mobile Bay.

7. Mobile Harbor ship channel extends from Chickasaw Creek to deep water in the lower bay, a distance of about 33½ miles. Disregarding the effect of dredging, the distance across the shoal on Mobile Outer Bar is about 3,800 feet. Between the bar and the outer or southern end of the Mobile Harbor ship channel there is a natural

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[1] Only three sheets printed.

depth of 30 feet or more with a width of from 1,000 to more than 2,500 feet for a distance of about 6 miles. The channel through Mobile Bay and River is at present fixed, but the best location for a channel across the bar is constantly shifting and for this reason the bar survey covers a considerable area.

8. The river, bay, and bar channels run generally through the following classes of material:

	Distance.	Material.
	Feet.	
Mobile River, Chickasaw Creek to beacon 22	25,385	Sand and clay; principally sand.
Beacon 22 to beacon 16 (cut-off channel)	18,108	Clay, sand, shell, and blue mud.
Beacon 16 to 14-A	8,178	Blue mud.
Beacon 14-A to 14	8,038	Blue mud and sand.
Beacon 14 to 12-A	8,281	Do.
Beacon 12-A to 12	8,227	Do.
Beacon 12 to 10-A	8,253	Blue mud and shells.
Beacon 10-A to 10	8,290	Do.
Beacon 10 to M-B-A	14,053	Do.
Beacon M-B-A to lower end of channel (250 feet south of beacon M-G.).	70,159	Blue mud.
Outer bar (between 30-foot contours)	3,800	Sand..

9. The present project for Mobile Bar was adopted on June 13, 1902, and provides for a channel 300 feet wide and 30 feet deep at mean low tide. Immediately before beginning work, the volume to be removed to complete a channel of the projected width and depth, with side slopes of 1 vertical on 5 horizontal, allowance being made for one foot overdepth, was estimated to be 290,618 cubic yards. Dredging was begun in October, 1903, and was continued at intervals until September, 1912, a period of about nine years, during which a total of 798,181 cubic yards was removed from the original site of the channel, notwithstanding which for completion there still remained to be removed a volume of sand estimated at 238,782 cubic yards. Evidently the deposit within the channel limits had averaged slightly more than 82,000 cubic yards annually, and observation showed that the rate of shoaling was increasing, the last determination of the annual rate being well over 110,000 cubic yards. Thus the amount of maintenance was also increasing and threatened to surpass the powers of the U. S. seagoing suction dredge *Charleston*, belonging to the Mobile district. Surveys showed that by moving 700 feet west the volume of dredging needed for the completion of the projected channel would be decreased one-third, and, due to the greater distance from the shoals to the eastward, it was believed that maintenance dredging would also be considerably reduced. Authority for shifting the channel was accordingly obtained, and between November 18, 1912, and March 26, 1914, it was completed, 313,079 cubic yards being dredged in making the channel 30 feet deep over a width of 300 feet. Some shoaling has since taken place, and this deposit, amounting in all to 58,418 cubic yards, was, during December, 1914, and January, 1915, removed by the U. S. seagoing suction dredge *Caucus*, belonging to the Montgomery district. The condition of the bar channel on June 15, 1915, is shown on Plate I, from which it is evident that the full depth and width are available, except near the wreck buoy at the north end of the channel, where a shoal has pushed the deep water to the westward. At this locality it is now necessary to dredge away the shaded portion of the shoal on the east side of the channel, and also to remove the wreck, which

is a very old one, whose existence was only recently disclosed by the shifting of the channel.

10. In order to get some idea of the rate and the character of the changes taking place on Mobile Bar, the 30-foot contours of various surveys since 1850 have been transferred to a single map, Plate II, which shows the position of these contours in 1850, 1892, 1902, 1904, 1908, 1913, and 1915. The contour for 1850 was taken from the Coast and Geodetic charts, and those for the remaining years mentioned from surveys made by this office. From this plate it is seen that since 1850 there has been a westward movement of the lower end of the natural deep channel forming the entrance to Mobile Bay. Measured on a line extending east and west through Sand Island Light, the width between 30-foot contours was 1,250 feet in 1850, 1,900 feet in 1908, and 2,150 feet in 1913. Between 1850 and 1913 the west side of this contour moved westward along this line a distance of 400 feet, and the east edge seems to have moved about 500 feet to the eastward. Measured on an east and west line through a point about 7,000 feet south of Sand Island Light, or 2,000 feet north of the outer end of the natural 30-foot channel, the sides of this 30-foot channel moved as follows:

Time.	Total movement west. west edge.	Annual average.	Total movement west, east edge.	Annual average.
	Feet.	*Feet.*	*Feet.*	*Feet.*
1850 to 1908	3,000	52	2,800	48
1892 to 1908	1,400	87½	1,400	87
1904 to 1908	200	50	400	100
1908 to 1913	150	30	150	30

Between 1850 and 1915 the extreme south end of the natural 30-foot channel moved 3,700 feet to the west—an annual average of 57 feet—the rate for shorter periods being as follows:

	Feet (about).
Between 1850 and 1892	48
Between 1850 and 1908	58
Between 1850 and 1913	57
Between 1850 and 1915	57
Between 1892 and 1915	73
Between 1904 and 1915	87
Between 1908 and 1915	50
Between 1913 and 1915	50

The rate of the westward movement of this natural deep water, extending from the lighthouse to a point 9,000 feet south, has thus lately been gradually decreasing, but it is still marked.

During the interval 1850 to 1915 the outer 30-foot contour on the bar moved 2,600 feet south. Disregarding the effect of dredging, the distance between 30-foot contours on the bar is now 3,800 feet, as against 2,800 feet in 1850.

11. The best location for a deep channel to be made across the bar at an early date is more or less indicated by the preceding data. The extreme outer end of the natural deep-water pocket into which the present dredged channel opens is now moving westward at the rate of about 50 feet per annum, but the general direction of the center line of this pocket is changing very slowly, and for some years has been substantially as shown on Plate I.

In order to form a channel across the bar having a depth of 35 feet, dredging would have to be carried approximately 7,000 feet below Sand Island Light, where the natural depth is now about 35 feet. Estimates for such a channel and for one having a depth of 33 feet have been prepared along two routes. In one case the east edge is identical with the east edge of the present dredged channel. In the other the route is to the westward of this position and in line with the deep-water pocket. Both locations are shown on Plate I. These estimates for a channel 450 feet wide, not including maintenance during construction, are as follows:

	Present location.		Western location.	
	Distance to be dredged.	Cubic yards, place measurement.	Distance to be dredged.	Cubic yards, place measurement.
	Feet.		*Feet.*	
35-foot depth, connecting the 35-foot contours across the bar	6,700	426,164	6,500	685,777
33-foot depth, connecting the 33-foot contours across the bar	5,700	207,778	5,600	470,630

The estimate of cost of dredging these channels by contract and by hired labor, using United States plant, is as follows:

Estimate of cost of channels, Mobile Bar.

Description of channel.	Item.	Cost.
35 feet, existing location	426,164 cubic yards:	
	By contract, at 20 cents	$85,300
	Contingencies	8,500
	Total	93,800
Do	426,164 cubic yards:	
	By hired labor, at 12 cents	51,200
	Contingencies	5,100
	Total	56,300
35 feet, west location	685,777 cubic yards:	
	By contract, at 20 cents	137,200
	Contingencies	13,700
	Total	150,900
Do	685,777 cubic yards:	
	By hired labor, at 12 cents	82,300
	Contingencies	8,300
	Total	90,600
33 feet, existing location	207,778 cubic yards:	
	By contract, at 20 cents	41,600
	Contingencies	4,200
	Total	45,800
Do	207,778 cubic yards:	
	By hired labor, at 12 cents	25,000
	Contingencies	2,500
	Total	27,500
33 feet, west location	470,630 cubic yards:	
	By contract, at 20 cents	94,200
	Contingencies	9,400
	Total	103,600
Do	470,630 cubic yards:	
	By hired labor, at 12 cents	56,500
	Contingencies	5,700
	Total	62,200

12. The U. S. dredge *Charleston*, belonging to this district, can move about 325,000 cubic yards per annum, and allowing 100,000 cubic yards annually for shoaling, the net amount annually taken from the bar channel would be 225,000 cubic yards. Hence this dredge could enlarge the channel in its present location to a depth of 33 feet over a width of 450 feet in one year, and could dredge a similar channel at the other location in about two years. The services of the *Charleston* are occasionally required at two other bars in this district, but it is believed that another suitable United States dredge might, if needed, be borrowed from some other district to help to make the deeper channel across this bar, the *Charleston* to be used also for maintenance work.

13. The cost of forming, by the use of United States plant and hired labor, a channel 33 feet deep at the location of the present channel will be, according to the above estimates, $35,000 less than for a similar channel at the other location. The time consumed in forming the channel where the present one is would also be considerably less. On the other hand, the inner end of the eastern edge of the channel at the present location is only about 300 feet from the 18-foot contour, which may be considered as defining the shoal proper, while that of the western channel is 600 feet away. This means that at the present rate of advance of the shoal—50 feet per year—the eastern channel would at the end of 6 years need a large amount of maintenance, while for the other channel it would be 12 years before extensive dredging will be needed. In these conditions the channel at the new or western location would ultimately prove more economical in total cost, and, as it involves no interference with the existing bar channel, which may be maintained by the *Charleston* coincidentally with the development of a new and deeper channel at the western location, apparently any deeper bar channel hereafter to be created should occupy the western site. A channel 450 feet wide and 33 feet deep at the western location is regarded as suitable, and is recommended as consistent with the enlarged channel herein proposed for Mobile Bay and River. Maintenance of this channel will involve the removal of about 100,000 cubic yards per annum. Allowing for the cost of up-keep of the dredge when not at work, the maintenance of the bar channel would cost $15,000 annually, and this amount should also be added to the estimate for each year that the channel is under construction.

14. The existing project for the improvement of Mobile Bay and Mobile River is that of the river and harbor act approved June 25, 1910 (H. Doc. 657, 61st Cong., 2d sess.), which provides for a channel 27 feet deep at mean low water, 200 feet wide in Mobile Bay, and 300 feet wide in Mobile River, with a turning basin at the upper end 600 by 800 feet. The estimated cost of this dredged channel, which is 33½ miles long from the turning basin to Beacon M–G in the lower or south end of Mobile Bay, was $1,802,548. This project was completed on July 18, 1914, the total cost, including $144,300 spent for maintenance while the work was in progress, being about $1,623,500, or about $179,000 less than the estimate on page 21 of House Document No. 657, Sixty-first Congress, second session.

Since its completion—a period of about 18 months—this channel has been maintained at the authorized depth and width. The present rate of shoaling is known with certainty. Between March, 1914, and July, 1915, cross sections 500 feet apart along the channel were sounded, and repeated measurements of the same sections were made, the purpose being to establish not only the rate of deterioration, but also the degree of permanency of the side slopes of the channel and the effect exerted upon the channel by the present method of wasting the spoil from the pipe-line dredges at a distance of about 1,000 feet from the west bank. Six sheets showing the cross sections opposite the beacons from beacon 16 to beacon M-G are herewith, being Plates IV to IX, inclusive. As seen, soundings were extended to points about 3,000 feet from the channel. From the evidence of these cross sections and of others not forwarded, it may be stated that the channel banks appear to be permanent at an average slope not gentler than about 1 vertical to 5 horizontal, not only at and near beacon 16 at the north end of the bay where the material is sand, but also at the south end of the channel where the material is soft mud. There is no evidence to show that the banks cave appreciably. Further, except where the material is sand or clay, the deposit of spoil by the dredge affects but little the depths near the place of deposit. At first there is a tendency to form a ridge or mound near the outer end of the pipe line and to raise the bottom in this vicinity. The dredged material is, however, generally soft and light and the mound is soon leveled off by the tidal currents, which serve also gradually to reduce the elevation of the bottom of the bay to its natural height, so that, a few months after dredging, there is no measurable effect that can be traced to the method of deposit of the spoil. The cross sections afford no reason for believing that the spoil finds its way back into the channel, and, as the preponderating tides are toward the west, and as the waves due to westerly winds have less fetch than those due to winds from the east, it is probable that deterioration is not affected by the comparative nearness to the west of the channel, of the place of deposit of the spoil. Where the material is sand or clay the spoil banks are persistent. They do not, however, have an important detrimental influence on the channel.

It is believed that comparatively little shoaling is caused by the rivers emptying into Mobile Bay near its upper end. Only one of these rivers empties directly into the dredged channel, while, as the muddy water from these streams during freshets would indicate, the deposit is spread more or less uniformly over the entire bottom of the bay. If the deposits over the entire bay were anything approaching the depth of the annual fill in the channel in a comparatively few years the bay would fill up.

While the channel has been completed so as to afford throughout a depth of 27 feet at mean low water and a width of 300 feet in the river and 200 feet in the bay for but little over a year, and while this is plainly too short a time to afford positive evidence as to the rate of deterioration, the evidence of these cross sections may safely be regarded as establishing the maximum rate of filling to be expected. Future deposit will probably be at a somewhat less rate because the slopes may be expected to solidify somewhat and should then yield even less to any causes that may tend to degrade them, while also the repeated use of the channel by deep-draft vessels will tend to familiarize pilots with the best way of handling the largest class of vessels, thus avoiding damage to the channel, and may at the same time, through the combined action of the propellers and current, tend to keep the channel scoured out.

From the cross sections the annual rate of shoaling for each mile of channel beginning at Chickasaw Creek has been computed in two different ways. The first set of cross sections for the first estimate was made directly after the completion of the 27-foot project, between March, 1911, and July, 1914, and the second set was made between January, 1914, and January, 1915, with an average interval of slightly more than two years between the two sets.

Based on the cross sections just described, the rate of shoaling for each mile, beginning at Chickasaw Creek, follows:

Mile No.	Location.	Rate of shoaling per year.
		Cu. yds.
1	Station 0+00 turning basin to station 7+51 tangent No. 2	111,119.8
2	Station 7+51 tangent No. 2, to station 8+47 tangent No. 3	95,041.6
3	Station 8+47 tangent No. 3, to station 61+27 tangent No. 3	51,110.4
4	Station 61+27 tangent No. 3, to station 42+82 tangent No. 4	77,185.2
5	Station 42+82 tangent No. 4, to station 4+78 cut-off channel	78,228.8
6	Station 4+78 cut-off channel to station 3+51 south of beacon 4, cut-off channel	150,076.6
7	Station 3+51 south of beacon 4, cut-off channel, to station 56+31 south of beacon 4, cut-off channel	114,576.0
8	Station 56+31 south of beacon 4, cut-off channel, to station 48+31 south of beacon 2, cut-off channel	131,758.5
9	Station 48+31 south of beacon 2, cut-off channel, to station 40+31 south of beacon 16	109,240.5
10	Station 40+31 south of beacon 16, to station 11+24 south of beacon 14–A	100,926.5
11	Station 11+24 south of beacon 14–A, to station 64+04 south of beacon 14–A	97,801.2
12	Station 64+04 south of beacon 14–A, to station 36+45 south of beacon 14	83,163.3
13	Station 36+45 south of beacon 14, to station 6+44 south of beacon 12–A	80,635.7
14	Station 6+44 south of beacon 12–A, to station 59+24 south of beacon 12–A	123,100.7
15	Station 59+24 south of beacon 12–A, to station 29+77 south of beacon 12	103,463.6
16	Station 29+77 south of beacon 12, to station 0+04 south of beacon 10–A	122,428.9
17	Station 0+04 south of beacon 10–A, to station 52+84 south of beacon 10–A	111,008.0
18	Station 52+84 south of beacon 10–A, to station 22+74 south of beacon 10	149,055.6
19	Station 22+74 south of beacon 10, to station 75+54 south of beacon 10	146,467.2
20	Station 75+54 south of beacon 10, to station 128+34 south of beacon 10	146,467.2
21	Station 128+34 south of beacon 10, to station 40+61 south of beacon M–B–A	222,502.7
22	Station 40+61 south of beacon M–B–A, to station 33+46 south of beacon 8–A	209,885.1
23	Station 33+46 south of beacon 8–A, to station 86+26 south of beacon 8–A	189,446.4
24	Station 86+26 south of becaon 8–A, to station 39+38 south of beacon 8	197,309.6
25	Station 39+38 south of beacon 8, to station 28+35 south of beacon 6–A	201,429.6
26	Station 28+35 south of beacon 6–A, to station 16+27 south of beacon 6	219,951.2
27	Station 16+27 south of beacon 6, to station 69+07 south of beacon 6	258,720.0
28	Station 69+07 south of beacon 6, to station 48+97 south of beacon 4–A	169,678.6
29	Station 48+97 south of beacon 4–A, to station 21+12 south of beacon 4	178,738.1
30	Station 21+12 south of beacon 4, to station 5+86 south of beacon 2–A	198,973.0
31	Station 5+86 south of beacon 2–A, to station 58+66 south of beacon 2–A	118,748.8
32	Station 58+66 south of beacon 2–A, to station 22+67 south of beacon 2	154,902.5
33	Station 22+67 south of beacon 2, to station 22+27 south of beacon M–G–A	110,746.8
33.526	Station 22+27 south of beacon M–G–A, to beacon M–G	39,665.7
	Total	4,743,645.4

Another estimate has been prepared from cross-section soundings made a sufficient length of time after dredging to eliminate any excess yardage due to suspended matter stirred up in dredging. The first set of cross sections upon which this second estimate is based was made between August, 1911, and July, 1914, and the second set was made between October, 1914, and July, 1915, and the annual rate derived from them is as follows:

Mile No.	Location.	Rate of shoaling per year.
		Cu. yds.
1	Station 0+00 turning basin to station 7+51 tangent No. 2	111,119.8
2	Station 7+51 tangent No. 2 to station 8+47 tangent No. 3	95,041.6
3	Station 8+47 tangent No. 3 to station 61+27 tangent No. 3	51,110.4
4	Station 61+27 tangent No. 3 to station 42+82 tangent No. 4	77,185.2
5	Station 42+82 tangent No. 4 to station 4+78 cut-off channel	78,223.8
6	Station 4+78 cut-off channel to station 3+51 south of beacon 4 cut-off channel	150,076.6
7	Station 3+51 south of beacon 4, cut-off channel, to station 56+31 south of beacon 4, cut-off channel	114,576.0
8	Station 56+31 south of beacon 4, cut-off channel, to station 48+31 south of beacon 2, cut-off channel	131,758.5
9	Station 48+31 south of beacon 2, cut-off channel, to station 40+31 south of beacon 16.	107,959.6
10	Station 40+31 south of beacon 16 to station 11+24 south of beacon 14-A	98,724.8
11	Station 11+24 south of beacon 14-A to station 64+04 south of beacon 14-A	93,931.2
12	Station 64+04 south of beacon 14-A to station 36+45 south of beacon 14	93,599.1
13	Station 36+45 south of beacon 14 to station 6+44 south of beacon 12-A	95,295.9
14	Station 6+44 south of beacon 12-A to station 59+24 south of beacon 12-A	108,768.0
15	Station 59+24 south of beacon 12-A to station 29+77 south of beacon 12	129,018.8
16	Station 29+77 south of beacon 12 to station 0+04 south of beacon 10-A	144,600.6
17	Station 0+04 south of beacon 10-A to station 52+84 south of beacon 10-A	109,032.0
18	Station 52+84 south of beacon 10-A to station 22+74 south of beacon 10	134,821.3
19	Station 22+74 south of beacon 10 to station 75+54 south of beacon 10	168,907.2
20	Station 75+54 south of beacon 10 to station 128+34 south of beacon 10	168,907.2
21	Station 128+34 south of beacon 10 to station 40+61 south of beacon M-B-A	135,430.3
22	Station 40+61 south of beacon M-B-A to station 33+46 south of beacon 8-A	110,096.8
23	Station 33+46 south of beacon 8-A to station 86+26 south of beacon 8-A	101,217.6
24	Station 86+26 south of beacon 8-A to station 39+38 south of beacon 8	121,405.5
25	Station 39+38 south of beacon 8 to station 28+35 south of beacon 6-A	126,539.8
26	Station 28+35 south of beacon 6-A to station 16+27 south of beacon 6	125,320.4
27	Station 16+27 south of beacon 6 to station 69+07 south of beacon 6	125,875.2
28	Station 69+07 south of beacon 6 to station 48+97 south of beacon 4-A	140,101.7
29	Station 48+97 south of beacon 4-A to station 21+12 south of beacon 4	128,420.7
30	Station 21+12 south of beacon 4 to station 5+86 south of beacon 2-A	107,082.5
31	Station 5+86 south of beacon 2-A to station 58+66 south of beacon 2-A	90,076.8
32	Station 58+66 south of beacon 2-A to station 22+67 south of beacon 2	96,776.1
33	Station 22+67 south of beacon 2 to station 22+27 south of beacon M-G-A	61,170.3
33.526	Station 22+27 south of beacon M-G-A to beacon M-G	0.0
	Total	3,732,171.3

The same cross sections were used in each estimate from mile No. 1 to mile No. 8, inclusive.

The difference of 1,011,474 cubic yards in these two estimates is probably due to the rapid fill occasioned by dredge *No. 21* of the Coastwise Dredging Co. This dredge was of a peculiar type, and is described below. Comparing the estimates from mile No. 21 to mile No. 33½—the portion of the channel worked over by this dredge—there is a difference of 1,051,181 cubic yards, or only 39,707 cubic yards more than the total difference between the two estimates. In order to further emphasize this the shoaling given in the two tables above has been divided at about the middle of the bay. The data thus consolidated follows:

Location.	Inclusive dates cross-section soundings were taken.		Average years.	Rate of shoaling per year.
	Initial.	Final.		
				Cu. yds.
Chickasaw Creek to mile No. 20.	March, 1911, to December, 1914.	January, 1914, to March, 1915.	2.15	[1] 2,222,949.3
Mile No. 21 to mile No. 33½.	November, 1911, to June, 1913.	June, 1914, to January, 1915.	2.03	[2] 2,520,696.1
Total				4,743,645.4

[1] Dredging was done between initial and final dates. Original soundings were taken directly after dredging, except from Chickasaw Creek to beacon 16, where soundings were taken six months or more after dredging.

[2] Dredging was done between initial and final dates. Original soundings were taken directly after dredging; also the final soundings.

Location.	Inclusive dates cross-section soundings were taken.		Average years.	Rate of shoaling per year.
	Initial.	Final.		
				Cu. yds.
Chickasaw Creek to mile No. 20.	August, 1911, to December, 1914.	October, 1914, to July, 1915.	1.83	[1] 2,262,657.6
Mile No. 21 to mile No. 33½.	March to May, 1914	June to July, 1915	1.22	[2] 1,469,513.7
Total				3,732,171.3

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[1] Dredging was done between initial and final dates. Original and final soundings taken six months or more after dredging.

[2] Dredging was done between initial and final dates. Original soundings taken 9 months or more after dredging. Final soundings taken about 6 months after dredging.

It will be noticed that in the first table both the initial and final soundings were made immediately after dredging was done, the former being made just behind dredge *No. 21* and the latter behind one of the hydraulic pipe-line dredges in this district belonging to the Government. In the latter table both the initial and final soundings were made a sufficient length of time after dredging to permit the settlement of any material that had been stirred up. These estimates would have agreed had it not been that dredge *No. 21* stirred up much more material, held in suspension while the initial soundings were made, than did the United States' hydraulic pipe-line dredge. The annual shoaling in the Mobile ship channel lies between these two estimates. The first one represents the amount actually dredged to maintain the improvement as increased by material stirred up by dredge *No. 21* in the lower half of the bay. The second represents the actual or net amount to be removed to preserve the improvement.

Dredge *No. 21* was of the seagoing hopper type. Her drag was about 10 feet wide and in it were placed several jets. It is believed that the action of these jets stirred up the very light material which the buried suction was then unable to remove. On the other hand, no jets are used on the hydraulic pipe-line dredges belonging to this district, and therefore no material is stirred up in this way. The revolution of the cutter does stir up a small amount, and the exact quantity has not been determined. It probably will not exceed one-half million cubic yards for the entire channel. This figure added to the net amount of shoaling, or 3,731,171, will give the amount per annum, about 4,200,000 cubic yards, which under normal weather conditions must be removed in order to maintain the channel at the project depth.

To this normal volume of deterioration must for safety be added the average amount of deposit that may be expected to result from the action of extraordinary storms, which are for the present purpose classed as storms with maximum velocity exceeding 50 miles per hour.

Since 1872 seven such storms have been recorded at Mobile as follows:

Date.	Maximum velocity.	Direction from.	Remarks.
	Miles.		
Aug. 20, 1888	56	Southeast	Water 3 feet deep over wharves.
Apr. 14, 1889	60	do	Some damage to property; trees blown down.
Oct. 2, 1893	72	do	During this blow wind reached an extreme velocity of 80 miles; several vessels washed ashore; trees uprooted; houses damaged; wholesale business district inundated, and stage of water said to be higher than at any time since 1852; 7 lives were lost in Mobile County; storm more destructive on the Mississippi and Louisiana coasts. Tide, 8.8 feet.
Aug. 15, 1901	60	do	Extreme velocity during the blow of 78 miles; a number of small vessels lost; wholesale business section inundated; bathhouses on shore of Mobile Bay washed away; bay shell road damaged; limbs of trees blown off; no loss of life. Tide, 8.23 feet.
Sept. 26-27, 1906	([1])	do	About 20 buildings, mostly houses in the residential district of Mobile, Ala., were demolished. The steeple of St. Francis Street Baptist Church was felled, and the steeple of Christ Episcopal Church was also blown down, carrying with it the roof and part of the walls of the building. Nearly all buildings were more or less damaged. Windows were blown in and other damage done. The tide exceeded all previous stages; wharves were greatly damaged and shipping suffered considerably. About 100 people were drowned in Mobile County. One-half of all timber within 75 miles of Mobile, Ala., boxed for turpentine, was blown down. Tide, 9.87 feet.
Sept. 20-21, 1909	47	do	No damage at Mobile, Ala. Tide, 8.7 feet.
Sept. 29-30, 1915	61	do	Tide, 7.2 feet.

[1] Not accurately known.

The most recent storm listed is that of September 29–30, 1915, and it throws some light on the amount of damage that tropical hurricanes may be expected to do. For this purpose soundings were made soon after the storm, and these have been compared with others made between June 28 and August 2, 1915. Allowing for normal deterioration during the period of observation, a comparison of soundings made before and after the storm shows a total fill from station 3+63 near Choctaw Point, to beacon M–G of slightly less than 1,350,000 cubic yards. Storms of the violent character of those listed occur on an average about every six years, so that by adding 250,000 cubic yards to the normal rate of deterioration liberal allowance is apparently made for damage due to unusually severe storms. Ordinary storms apparently do little or no damage. Accordingly, the annual fill in the channel due to all known causes is apparently somewhat less than 4,450,000 cubic yards, and in the discussion that follows it is roundly stated at 4,500,000 cubic yards. In all probability this last figure is, for reasons already given, greater than would be experienced at the end of a few years, and there is no evident reason why the volume of shoaling of a 27-foot channel 300 feet wide should be any greater than that now derived for the 200-foot channel.

Estimate of material washed into the Mobile ship channel by the storm of September, 1915.

[Originals taken June 28 to Aug. 2, 1915; final soundings taken Oct. 6, 1915; 0.237 year between initial and final dates.]

Station.	Area.	Double area.	Mean area.	Distance.	Volume.
Beacon:				*Feet.*	*Cubic feet.*
16	675.0				
14-A	265.0	940.0	470.0	8,187	3,847,890.0
14	217.5	482.5	241.3	8,039	1,939,810.7
12-A	300.0	517.5	258.7	8,281	2,142,294.7
12	182.5	482.5	241.3	8,227	1,985,175.1
10-A	375.0	557.5	278.7	8,253	2,300,111.1
10	175.0	550.0	275.0	8,290	2,279,750.0
8-C	70.0	245.0	122.5	7,026	860,685.0
8-B	220.0	290.0	145.0	7,027	1,018,915.0
8-A	392.5	612.5	306.3	5,995	1,836,268.5
8	445.0	837.5	418.7	9,968	4,173,601.6
4	757.5	1,202.5	601.3	28,226	16,972,293.8
2-A	380.0	1,137.5	568.7	6,806	3,870,572.2
2	532.5	912.5	456.3	8,879	4,051,487.7
M-G-A	512.5	1,045.0	522.5	5,320	2,779,700.0
M-G	295.0	807.5	403.7	5,005	2,020,518.5
Total					52,079,073.9 *Cubic yards.* 1,928,854.6
Average rate of shoaling, beacon 16 to beacon M-G for 0.237 year (0.237×2,891,507.3)					685,287.2
Washed into channel by storm (beacon 16 to beacon M-G)					1,243,567.4

Estimate of material washed into the Mobile ship channel by the storm of September, 1915.

[Originals taken June 28 to Aug. 2, 1915; finals taken Oct. 25, 1915; 0.256 year between initial and final dates.]

Station.	Area.	Double area.	Mean area.	Distance.	Volume.
				Feet.	*Cubic feet.*
3+63 cut-off channel	0.0				
Day mark 6	332.5	332.5	166.3	2,000	332,600.0
Beacon 4	0.0	332.5	166.3	3,040	505,552.0
Day mark 4	270.0	270.0	135.0	3,040	410,400.0
Beacon 2	442.5	712.5	356.3	3,040	1,083,152.0
Day mark 2	557.5	1,000.0	500.0	3,040	1,520,000.0
Beacon 16	630.0	1,187.5	595.7	3,040	1,804,848.0
Total					5,656,552.0 *Cubic yards.* 209,501.9
Average rate of shoaling, station 3+63 cut-off channel to beacon 16, for 0.256 year (0.256×427,900.9)					109,542.6
Washed into channel by storm					99,959.3

SUMMARY.

	Cubic yards.
Beacon 16 to beacon M-G	1,243,567.4
Station 3+63 to beacon 16	99,959.3
Total	1,343,526.7

15. The rate of deterioration of the present 27-foot channel affords the best evidence concerning the probable cost of maintenance of a 30-foot channel, which, as stated in the report on the preliminary examination dated May 21, 1913, is believed to be required for the proper accommodation of the commerce of Mobile Harbor. Previous investigations, more particularly those reported in House Document 657, Sixty-first Congress, second session, pages 28 and 29, as well as the evidence of the present survey, go to show that shoaling is not largely due to the caving of the banks, which, rather, appear to be

relatively stable, nor does the bed of the channel rise or the sides flow in. Apparently shoaling in the bay is due principally to the tidal currents, which generally do not coincide in direction with the dredged channel. These tidal currents are charged with material of low specific gravity (about 1.3) brought from a distance, which is deposited in the channel. Apparently the material carried by the cross currents falls into the trough or ditch, which the channel in reality is, and due to reduced velocity of the currents, its weight prevents its ascent of the opposite bank. In the upper part of the bay and in the river, shoaling is caused by sand, which is moved mostly during freshets. The part of the channel so affected is north of beacon 16.

16. From the experience had in forming the 27-foot channel it is not probable that the volume of deposit in a channel 30 feet deep would be very much greater than in one of the same width, 27 feet deep. The study of Plates IV to IX and of other similar cross sections tends to show that the deposit is of practically uniform thickness across the bottom of the channel, as might be expected were the shoaling caused by material brought from a distance, and not by caving or subsidence of the banks. The cross sections afford no evidence that the dredged cut is closed by the gradual encroachment of flowing in of material from the banks, although, as might be expected in a narrow channel, the suction of deep-draft steamers may cause damage to the banks and increase deterioration. Deposit in a channel 30 feet deep should apparently, therefore, be greater than in a channel 27 feet deep only to the extent of the effect of the increased depth on the area of the cross section through which the tidal currents flow and on the carrying capacity of the tidal currents, or about 25 per cent greater than in a 27-foot channel—namely, about 5,600,000 cubic yards annually. This will be light material, easily dredged.

17. Estimates have been made for channels in Mobile Harbor 27 feet and 30 feet deep over a width of 300 feet, with side slopes of 1 on 5, 1 foot being allowed for overdepth in dredging. The eastern edge of the channel in the bay coincides with the eastern edge of the present channel. The beacons are on this side of the channel, and it is not deemed advisable to dredge nearer to them. All widening proposed to be done is therefore to the westward. The present channel in Mobile River is already 300 feet wide, and the location of the proposed channel coincides with it. The estimates, which do not include maintenance during construction, follow:

Estimate of cost of channels 27 feet and 30 feet deep, 300 feet wide, Mobile Harbor.

Depth.	Item.	Cost.
27 feet	11,678,245 cubic yards:	
	By contract, at 7½ cents	$876,000
	Contingencies	89,000
	Total	965,000
Do	11,678,245 cubic yards:	
	By hired labor, at 4 cents	467,000
	Contingencies	48,000
	Total	515,000

Estimate of cost of channels 27 feet and 30 feet deep, 300 feet wide, Mobile Harbor—Continued.

Depth.	Item.	Cost.
30 feet	16,268,092 cubic yards:	
	By contract, at 7½ cents	1,220,000
	Contingencies	125,000
	Total	1,345,000
Do	16,268,092 cubic yards:	
	By hired labor, at 4 cents	651,000
	Cost of one dredge, complete	305,000
	Contingencies	74,000
	Total	1,030,000

Maintenance by the use of United States plant and hired labor of the wider 27-foot channel will cost no more than that of the existing 200-foot wide channel of the same depth, namely, $100,000 annually, and for the 30-foot channel the cost of annual upkeep will not exceed $150,000. These amounts should be added to the corresponding estimates for each year that the work of deepening or widening is in progress.

For comparison with these figures and in compliance with directions of the second indorsement upon the original report of January 23, 1914, an inclosed channel or canal along the west shore of Mobile Bay has also been considered. Paragraph 5 of the first indorsement upon the report of January 23, 1914, states that a deep channel in this location would probably be cheaper to construct and maintain than one along the present location in the middle of Mobile Bay. Accordingly, a channel has been laid out as directed, and is shown on Plate III. It is virtually a canal from beacon 16 to near Cedar Point. Thence to beacon M-G it is impracticable to protect it by walls and the channel is an open cut. North of beacon 16, use is made of the present channel, because above beacon 16 shoaling in the present channel in the bay is relatively small, probably no greater than it would be farther west, and in the river no change is possible. Borings made along this location are given on an inset upon Plate III, and show that the material is of much the same character as that found in the present channel, the borings of which are on the same plate. It is therefore probable that spoil banks deposited to the east of the channel to aid in protecting it from storms would not be any more permanent than the present spoil banks are, and unless a bulkhead or retaining wall of some kind were placed immediately west of the spoil banks, storms and high tides would sweep them into the canal and make its maintenance very expensive. The simplest, and perhaps the only type of bulkhead that could be built at the site, is some form of close-pile structure. This bulkhead should be carried south only to the 11½-foot contour, or just north of the angle in the channel opposite Cedar Point. Beyond that point the cross tides, the exposure, and the very soft bottom make such construction and its maintenance difficult. Even north of Cedar Point piles would not be very secure in the soft bed of Mobile Bay, and storms would make their maintenance relatively costly. The type of bulkhead tentatively considered is to be built about 1,000 feet from the east bank of the channel, using untreated round piles driven as closely as practicable. The piles would be about 25 feet long, cut off about 1 foot above mean low water, connected along their channel face by timber stringers, and secured to anchor piles every 15 feet. This low wall would break the force of storms without undue damage to the structure. Dredged material should be pumped over and beyond it. A number of small streams, of which Dog, Deer, and Fowl Rivers are the most important, would empty into this canal. During freshets these streams carry considerable sand, and as local rains of considerable severity are quite frequent the suggested canal might occasionally be obstructed by this sand and expensive dredging required. To deflect the discharge of the three rivers named and to confine the deposit of sand within desirable limits, deflective bulkheads or walls might be built, but they would be expensive, would require considerable maintenance, and would after all be of merely temporary service.

From beacon 16 to beacon M–G the length of the proposed channel along the western side of Mobile Bay is nearly 1½ miles greater than that of the present channel. To prevent sheering, vessels would also have to run at a much less speed in the restricted channel, and for these two reasons more time would be consumed in making the trip along the proposed channel than along the present one.

The proposed canal is planned to be 300 feet wide and 30 feet deep with side slopes of 1 on 5. Allowing 1 foot for overdepth, this channel is estimated to cost as follows:

Removing by contract:	
47,249,571 cubic yards, at 7½ cents	$3, 544, 000
Contingencies	356, 000
	3, 900, 000
Construction of 102,000 feet of bulkhead along eastern side of the canal, of wooden piles	615, 000
Total	4, 515, 000
Removing by day labor:	
47,249,571 cubic yards, at 4 cents	1, 890, 000
Cost of three dredges, complete	915, 000
Construction of 102,000 feet of bulkhead along eastern side of the canal, of wooden piles	615, 000
Contingencies	190, 000
Total	3, 610, 000

The amount of annual deterioration of this alternative channel is of course uncertain. In the 7 miles below Cedar Point shoaling should proceed at the same rate per mile as in the corresponding portion of 30-foot channel at the site of the existing channel—about 150,000 cubic yards annually. Between Cedar Point and beacon 16 the rate of shoaling should be less, but as the tide has free access to the canal, due to tidal action some shoaling will undoubtedly take place, to which must be added the volume of sand brought in annually by the tributary streams. Experience with protected channels in this district, such as those at Wolf and Jordan Rivers in Bay St. Louis, shows that they deteriorate quite rapidly, the annual rate being at least 35,000 cubic yards per mile, and this rate is here assumed, but no allowance is made for the effect of the entering rivers. Above beacon 16 the rate of shoaling would be that of the present channel, allowance being made for the increase in the rate of shoaling due to deepening the channel to 30 feet. The annual shoaling in the channel at the western location would then be as follows:

	Cubic yards.
Turning basin to beacon 16	1,060,000
Beacon 16 to Cedar Point (about 19 miles)	665,000
Cedar Point to beacon M–G (about 7 miles)	1,050,000
Total	2,775,000

The cost of removing the portion of the annual fill occurring within the canal limits would be greatly increased by the necessity of placing the spoil on the bank or raising it over the bulkhead, and in the river the material must be placed on shore, many interruptions being caused by logs and refuse getting into the cutter and by the difficulty of shifting the heavy discharge line. This part of the annual shoaling—1,725,000 cubic yards—would cost at least 6 cents per yard to remove, whereas the remainder, being mostly soft and light material, ought to be removed at an average cost of close to 2½ cents. (See Report of the Chief of Engineers, 1914, Appendix KKK, p. 3960, item 106.) The cost of maintenance dredging would therefore be about $130,000, to which must be added the cost of maintaining 19 miles of pile bulkhead at approximately 10 per cent of its first cost, or $61,000 annually, making the total cost of maintenance $191,000.

Thus the alternative channel of the westerly location would, including its bulkhead, cost considerably more to maintain than the 30-foot channel at the existing location, and in addition, assuming construction by hired labor and use of United States plant, its first cost would be greater by over $2,500,000. It would appear therefore to be more economical to deepen the existing channel.

18. There are three 20-inch pipe-line dredges belonging to this district, and these are more than sufficient for maintaining the inner channels of all the harbors. At least one of these dredges would constantly be available for use in enlarging the Mobile Harbor channel. If the work is undertaken, it would seem to be economy to form the channel with United States plant, but in order to complete it within, say, four years, one additional dredge would have to be built for the 30-foot project, at the site of the existing channel, and three additional dredges for the westerly location. A 20-inch pipe-line dredge with attendant plant, including pipe-line, water and coal barges, and seagoing tug, costs about $305,000, and even though no employment could, after completion of the enlarged harbor channel, be found either in this district or any other for the single new dredge required for the 30-foot channel at the present site, this dredge might be abandoned or given away, and the United States would still have profited by its use. It is believed, however, that at least one additional 20-inch dredge will be needed part of the time for the trustworthy maintenance of a 30-foot channel 300 feet wide, so that the new dredge might be of value as a reserve. The execution of the work by hired labor and the use of United States plant possesses therefore not only the advantages of greater flexibility and adaptability to the immediate needs of commerce, but also those of economy and, ultimately. greater ease and certainty of maintenance.

19. Commercial interests at Mobile claim that a channel 30 feet deep in the harbor and 35 feet deep across the bar is needed for the proper accommodation of the export business that now uses this

port and to permit its use by that which would seek it or is naturally tributary to it. Moreover, the general opinion is that Mobile, with natural advantages at least equal and in some respects possibly superior to those of rival Gulf ports, has been placed in a position of inferiority by the fact that they have channels at least 30 feet deep, while Mobile is known to shipping interests as a 27-foot harbor. Similarly most of the larger harbors of the South Atlantic coast, few of which have greater natural advantages than Mobile, have channels which, at least at high tide, permit the use of vessels drawing 30 feet or more. Local interests are accordingly anxious that Mobile shall be placed upon a footing of equality with its rivals. The 27-foot channel has been completed and available for only about a year and a half, during which commercial conditions have been abnormal, so that it is not demonstrable that the present project will prove inadequate to the needs of the immediate future. Yet there is considerable support for the contention that 27 feet will not prove sufficient. In the first place Mobile is without the advantage of really helpful tides. Ordinarily the tidal rise does not, anywhere in the improved harbor, exceed 1.4 feet, and, on the other hand, northers, which during the winter months, are frequent and sometimes prolonged, may depress the water surface as much as 1.4 feet below mean low water. Large vessels, when loaded to full draft, usually plan to take advantage of high tide, so that northers may reduce the permissible draft by 3 feet. Accordingly, during these months, less than 27 feet might be available, thus causing expensive delays to vessels loaded to the full nominal depth of the authorized channel. This fact is well known and serves to militate against the port. The disadvantage due to northers would of course exist also in the case of the proposed 30-foot channel.

It is also known that the vessels generally used in over-seas business are constantly increasing in size and in draft, and that the port having depth sufficient to accommodate the freight steamer of the usual size will be favored at the expense of another near by to which only a limited class and number of vessels can come, because, in the case of the latter, vessels of the restricted size may not be available precisely when wanted, while to send a larger vessel to be loaded to part capacity only, would involve either undue expense for fuel, supplies, labor, and overhead charges, or the extra cost of completing cargo and loading bunker coal at some deeper port. In this connection, attention is invited to the accompanying letter dated October 29, 1915, from the Mobile Liners (Inc.).

While the Panama Canal may influence favorably the business of Mobile, still greater benefit should flow from the recent completion of the waterway to the Warrior coal basin by way of the canalized Black Warrior, Warrior, and Tombigbee Rivers. High-grade steam coal is now being brought in steadily increasing quantities to Mobile by water, and bunker as well as cargo coal may now be furnished vessels at prices considerably lower than at near-by ports. Iron products of the Birmingham district should also eventually come to Mobile by water and furnish a supply of the dead-weight cargo so badly needed to bring cotton carriers down to their ordinary draft. Under normal conditions Mobile will then offer undoubted advantages which should prove attractive to the larger class of vessels. The situation of the port is further improved by the recent action of the Interstate Commerce Commission with respect to cotton rates, fully described in the accompanying letter of September 14, 1915, from the Mobile Chamber of Commerce. As explained in this letter, the commission has, after protracted negotiations, finally issued a mandatory order requiring the railroads to abandon the practices and to adjust the rates under which hitherto cotton and cotton products from territory geograpically tributary to Mobile have been carried to ports considerably farther from the point of shipment. In the same letter attention is drawn to a recent reduction in railroad freight rates to Mobile on pig iron, cast-iron pipe, and other iron products, such reductions being probably based upon the competition of the canalized water route. These recent developments add to the advantages the port of Mobile already has and should afford additional inducements to large freighters.

Furthermore, all wharf facilities at Mobile have now been rendered generally available by the order of the Interstate Commerce Commission, referred to in the same letter from the Mobile Chamber of Commerce, requiring the railroads to impose a uniform terminal charge of 3 cents per hundred pounds on all export freight. This subjects all freight to the same treatment, whereas, hitherto the railroads have absorbed the terminal charge on freight shipped on joint bills of lading for export via their wharves and their affiliated steamship lines, and they have refused joint bills of lading for freight destined for other wharves and nonaffiliated carriers. As a result of this decision, Mobile is now an "open" port in the sense that freight may be consigned for export to any wharf or waterside warehouse in the harbor of Mobile without disadvantage to such of it as goes to private or independent wharves, and that it may be exported on equal terms either by way of a steamer with railroad affiliations or by a tramp or independent steamer.

The preceding are the general arguments in favor of increasing the depth of the channel across Mobile Bar and in Mobile Harbor. Accompanying this report and bearing further on the question under consideration are letters from the joint rivers and harbor committee, from the Elder-Dempster Line Agency, from the Mobile Liners (Inc.), from the Mobile & Ohio Railroad Co., from Mr. Murray Wheeler, local agent for Lloyds, from the Mobile Coal Co., from Messrs. James Gibboney & Co., agents for the Munson Steamship Line, from Messrs. Page & Jones, steamship agents, from the harbor master of the port of Mobile, and from the Mobile Cotton Exchange. Attention is especially invited to the three letters first enumerated in which very full consideration is given to the need for further channel improvement at Mobile. These letters were written before the completion of the 27-foot channel, which fact explains certain statements as to the available draft.

Due to the straightening of the channel between Choctaw Point and beacon 16, Mobile has recently been relieved of disabilities due to relatively high marine insurance rates, but even now an extra premium of one-sixteenth of 1 per cent is levied upon vessels loading only in part and going to other ports to complete cargo. On a cotton cargo, this excess premium involves a total charge of from $600 to $1,500. With a deeper channel and an annual movement of 300,000 bales, as in the calendar year 1912, the saving from this cause alone would have aggregated $30,000 to $40,000 annually, and on the shipments of the cotton year 1913 to 1914, which increased about 40 per cent, the saving would have been correspondingly greater.

An increase in channel depth so that the largest class of vessels may load here would also result in a reduction of freight rates. While such rates vary with the demand for and the supply of ships, the differences in the rates charged by the various sizes of carriers remain approximately constant, and it is figured that increasing the depth from 27 feet to 30 feet will, on logs and lumber, reduce the export freight rate per thousand board feet by between $0.93¾ and $1.25. The saving on a shipment of say 3,000,000 board feet (about 1,500 standard) would be between $1,400 and $1,875. (See letter herewith from Mobile Liners (Inc.), dated Jan. 8, 1914.) The total saving on the export lumber business of the calendar year 1912 would have been over $350,000. Similar savings should result on cotton and on other classes of cargo; and if, as is predicted, the recently ordered adjustment of railroad rates to Mobile causes the total cotton shipments to reach 1,000,000 bales annually, the aggregate saving of freights due to increasing the channel depth from 27 feet to 30 feet, should be well above $500,000. The letter from the joint rivers and harbor committee of the chamber of commerce, dated December 29, 1913, herewith shows that foreign exports from the port of Mobile during eight months in 1913 increased about 78 per cent over the corresponding period of the preceding year. The recent change in the rates and the practices of the railroads should place Mobile in a much more favorable position as a cotton port, and the growth shown in 1913 should be followed by a further advance when business again becomes normal.

20. Increase in the facilities furnished by the United States at the harbor of Mobile would be justified if the benefits thereby conferred upon the public in general were such as in the aggregate to constitute a generous return upon the expenditure involved. The territory tributary to Mobile, described in the letter of the chamber of commerce of September 14, 1915, is so extensive and productive that it seems probable that the annual saving in freights and in insurance, due to increasing the depth to 30 feet, would be from $350,000 to $400,000 greater than the sum of the increased annual cost of maintenance of the 30-foot channel and of the interest on its first cost. The saving would accrue to the public in general, and the consequent expansion of business should prove of advantage to real estate values and industrial and agricultural development in the territory tributary to Mobile. As a business proposition the deeper channel recommended in the following paragraph seems to possess sufficient merit to justify the undertaking.

21. Experience with the existing channel in the bay shows that its width—200 feet—is not sufficient. So narrow a channel as this is subject to greater deterioration than would result from purely natural causes. The suction of large vessels passing through it must damage the banks, and occasional accidents in navigation, causing vessels to rub or to ground on the banks, add to the damage. Whether the depth be increased or not it would appear desirable to increase the width of the channel in the bay by 100 feet, making the total width 300 feet, the same as now exists in Mobile River. The wider channel should apparently be no more expensive to maintain than the existing channel. The estimated cost of thus increas-

ing the width of the channel in the bay (see par. 17) is $515,000, while the cost of dredging the channel throughout to the same width and to a depth of 30 feet is $1,030,000. Thus the added cost of the 30-foot channel is about $515,000, a sum not unduly large in view of the estimated benefits. A bar channel 33 feet deep and 450 feet wide should be ample for vessels capable of using the 30-foot channel in the bay.

For the immediate future a channel across the bar 33 feet deep and 450 feet wide, and a channel in the bay and river 30 feet deep and 300 feet wide at the bottom seem to be justified by the extent of the commercial interests involved and to promise satisfactory facilities for commerce, and I recommend that such channels be provided, the bar channel to be dredged at the westerly location, described in paragraph 11, at a cost of about $62,200, and the channel in the bay and river to be executed at the present location by hired labor and United States plant at a cost of about $1,030,000 (see par. 17), the total cost of the work, regarded as a single improvement, being $1,092,200, to which must be added the cost of maintenance as discussed in the following paragraph.

22. At the westerly location the volume of deposit in the bar channel should for a number of years to come be comparatively small. From past experience it seems safe to assume that annual maintenance should require the removal of not to exceed 100,000 cubic yards, which would cost $15,000. In paragrah 14 it is figured that the volume of deposit in the dredged channel in Mobile Bay and River has, in the past 14 months, been at the rate of about 4,500,000 cubic yards annually, and that the proper maintenance of the 30-foot bay and river channel should apparently necessitate the removal of about 5,600,000 cubic yards annually, at a cost of about $150,000. Assuming that the completion of the channels herein recommended would take four years, the total cost, including maintenance, would then be $1,750,000, of which amount $850,000 should be appropriated in the initial appropriation and the remainder in three equal installments, the entire work to be completed in not to exceed four years, and in less time should conditions prove favorable.

23. The transfer and terminal facilities of the port of Mobile have not been altered or increased since the rendition of the preliminary report and are fully described on pages 771 to 800 of House Document No. 226, Sixty-third Congress, first session. So far as concerns the deep-draft traffic, only the wharves of the New Orleans, Mobile & Chicago Railroad Co., pages 771-774; the Turner Terminal (formerly Turner-Hartwell) Co., pages 774-776; the Louisville & Nashville Railroad Co., pages 785-786; the Mobile & Ohio Railroad Co. and Southern Railway Co., pages 786-792, and of the city of Mobile, pages 792-793, are of any direct importance, and of these the Louisville & Nashville Railroad Co. wharves do little or no business carried by large vessels, practically all the business of these wharves being done by rather small steamers carrying bananas. All the preceding wharves are below One Mile Creek, on the west or right bank of the river. There is no adequate development on the east side of the harbor, and practically none on the west side above One Mile Creek, or between the Louisville & Nashville wharf and the Turner Terminal, where at the present an important part of the harbor is either unimproved or devoted to uses that might be equally well served at

other less valuable localities on the water front. On Plate X are shown the terminal facilities in Mobile River below the upper limit of the present project, and on the same plate is a table giving further valuable details concerning these wharves. It should be noted that the tabulated percentage of maximum capacity now in use relates to a period of abnormally low traffic. Since July. 1914, the war in Europe has caused a great decline in navigation and has arrested further development of the port, and it is difficult to predict with certainty what the relation between the demand for and the supply of wharves and terminal facilities will hereafter, in normal times, be. The report on the preliminary examination, dated May 21, 1913, contained the commercial statistics of the calendar year 1912, since which time have become available the figures for the calendar year 1913, a period of normal development, and for 1914, during the latter five months of which the war in Europe caused an almost complete cessation of traffic. For convenience the figures for the years 1913 and 1914 are consolidated in a single table as follows:

Freight traffic.

Articles.	Short tons.		Valuation.	
	1913	1914	1913	1914
Asphalt	6,573	81	$70,197	$1,458
Bananas	121,596	112,441	1,246,616	1,256,325
Breadstuffs	56,138		2,664,731	
Brick		360		1,440
Cement	1,038	112	10,365	1,120
Chicle	16		9,682	
Coal	44,085		188,136	
Coal and coke		52,433		157,300
Cocoanuts	922	3,758	91,344	78,404
Coffee		122		25,526
Cotton and cotton products	78,951	49,805	20,040,714	11,941,282
Crossties	22,319	72,358	118,716	466,820
Fertilizers	7,177	1,324	127,938	33,100
Fish and oysters	5,783	2,368	189,016	125,273
Flour		52,967		2,399,713
Grapefruit		798		16,611
Hay and grain	44,806	50,547	1,179,257	1,750,168
Hardwoods	608		11,257	
Hides and skins		35		9,800
Hog products	8,791	8,566	1,923,166	1,451,633
Iron pyrites	43,079	62,511	142,206	193,451
Kainit	15,448	24,412	124,596	138,857
Live stock	666	436	190,467	62,300
Logs	15,903	11,590	233,274	285,478
Lumber and timber	859,983	830,056	9,228,604	8,356,784
Manufactured goods	28,859	846	2,076,848	60,912
Manufactured steel and iron		6,351		635,100
Manure salts		3,722		34,826
Molasses, crude		63,867		812,857
Nails		367		27,491
Naval stores	36,335	31,908	1,586,354	972,188
Oil, refined and crude		28,280		1,234,550
Paper stock		1,002		13,153
Paving blocks, creosoted		5,238		104,760
Pig iron		4,813		52,360
Piling		91		1,063
Pineapples	923	6,460	188,309	210,532
Pipe, cast iron		22,069		537,601
Potash	2,047		71,274	
Potash salts		2,700		90,523
Salts		547		10,980
Shingles		192		3,273
Sisal grass	11,810	52,244	1,398,890	4,815,354
Staves	89,772	76,614	956,771	735,495
Sugar	517	276	53,681	33,096
Wool		230		115,125
Miscellaneous	93,155	113,560	7,182,470	11,353,580
Total	1,597,300	1,768,457	51,304,879	50,610,612

From reference to the table it will be seen that the tonnage of import and export traffic seems to be increasing, although, due to the falling off of cotton exports in 1914, the value of the business of that year declined. It can not be doubted that, with the reduction in railroad freight rates on cotton and the enforcement on the railroads of equality of treatment of all wharves and of all steamers, the business of the port is likely to increase both in tonnage and in value. The wharf facilities at present available for ocean-going ships and their cargo are, with the exception of the Turner Terminal, the city wharf, and two or three of the Mobile & Ohio piers, neither modern, well-adapted, nor have they in the past been sufficient for the normal business of the port. Some relief will result from the removal of restrictions which have hitherto militated against the free use of the wharves, slips, and warehouse of the Turner Terminal Co., but whenever the cotton and lumber business resume their natural proportions and growth, it will be found that the port lacks wharf space and warehouse room. The natural place to provide those would be on the sites of the existing old and inadequate wharves, and on the west bank of the river between the Louisville & Nashville wharf and the Turner Terminal. Other possible locations not so convenient are One Mile Creek and Blakely Island on the east side of the river. Blakely Island might be made accessible by means of a relatively inexpensive pontoon bridge, similar to those at Reads Landing and McGregor on the upper Mississippi River. It should further be noted that the city wharf, while comparatively modern, is of the bulkhead type, and does not develop the maximum usefulness of its valuable site. Slips and modern warehouses of at least two stories might profitably be substituted. If the port is to grow and prosper it must soon be equipped with economical means of access to localities not situated upon the water front, and must adopt a comprehensive plan for systematic development, including the regulation of charges for pilotage, now apparently excessive, the abolition of compulsory employment of tugs for ships and vessels in the river, the construction of a belt railway or its equivalent, and more liberal and economical means for the transfer of cargo, including coal terminals.

At the last session of the legislature of the State of Alabama, five acts were passed more or less affecting the further development of the facilities of the port. These bills were:

First. Bill granting city of Mobile the right to purchase water front and improve same for terminals, also to construct railway tracks, switches, etc.

Second. Bill giving city of Mobile right to issue bonds for the purchase of water front and the necessary development for terminals, and for construction of railway tracks, switches, etc. This bill creates the machinery for carrying out the first bill.

Third. Bill giving city of Mobile the right to use the land known as Sand Islands, property of the State—and formed by deposit from Federal dredging just below city in Mobile Bay—as a site for water terminals; this grant being subject to right of State of Alabama, in 20 years, to redeem the property by payment for improvements made by the city of Mobile.

Fourth. Bill giving river front or riparian owners the right to wharf out from land abutting upon Mobile River and Bay into the waters of Mobile River and Bay up to the State harbor lines, and authorizing such owners to make reasonable wharfage and other charges for use of their properties and terminal improvements.

Fifth. Bill creating a State harbor commission, to be appointed by governor of State, with authority to purchase water frontage and make necessary improvements in wharves and warehouses, to construct railway tracks, etc., to issue bonds that would be a lien upon such properties and improvements; and empowering such State harbor commission to set State harbor or wharf lines within harbor; giving them jurisdiction over pilots, the mooring of vessels in harbor—in fact, giving them supervision generally over the harbor.

Before further improvement of Mobile Harbor is undertaken by the United States, it seems that the terminal facilities of the port should be improved and supplemented, and either the State harbor commission created by the fifth act or the city of Mobile should be required to present comprehensive plans for additional terminals based upon a full consideration of the present and prospective requirements of the port, and to state fully and definitely when construction under the accepted plan is to be begun and completed. Until the terminal facilities of the port have been made modern, satisfactory, and completely adequate, there can be but little benefit in increasing the depth of the channel. With proper guaranties as to terminal improvement the deepening of the channel might be simultaneously prosecuted.

24. In closing it seems desirable to add that the United States has already spent over $20,000,000 for the improvement of navigation in Mobile Harbor and upon the streams whose traffic should naturally and economically seek that harbor either as a terminus or as a point of transfer to ocean carriers. In order that the utmost advantage may flow from this expenditure, it seems clear that, so far as possible, all obstacles to the growth of the port of Mobile be removed. Of such obstacles the restricted depth on the bar and in the harbor seems at present the most important.

25. The further improvement of this harbor involves no question as to water power, forestation, or flood control.

26. The specific conclusions and recommendations of the foregoing report are, therefore, as follows:

(*a*) That the channel along the western edge of the bay would be more expensive to create and to maintain than one along the existing location.

(*b*) That the present method of depositing the spoil 1,000 to 1,200 feet from the west edge of the channel causes no observable damage to the present channel, nor do the banks cave or slide in abnormally.

(*c*) That severe storms which occur about once every seven years increase the normal rate of shoaling of the present 27-foot channel from 4,200,000 to 4,500,000 cubic yards annually.

(*d*) That it will be advantageous to widen and deepen the existing channels across Mobile Bar and in Mobile Harbor.

(*e*) That the channel across the bar should be made 450 feet wide and 33 feet deep.

(*f*) That this channel should be dredged at the western location by hired labor and the use of United States plant, at a total cost of $62,200.

(*g*) That maintenance of this channel will involve the removal of not to exceed 100,000 cubic yards annually, and that the work of maintenance should be carried out by the use of the U. S. dredge *Charleston*, at an estimated annual cost of $15,000.

(*h*) That the existing channel in Mobile Harbor, from Chickasaw Creek to deep water near Fort Morgan, should be made 300 feet wide and 30 feet deep.

(*i*) That this channel should be improved by hired labor and the use of dredges now owned or hereafter to be built by the United

States, the total cost of dredging, including the first cost of such new dredges, being $1,030,000.

(*j*) That the maintenance of the Mobile Harbor channel will involve the removal of about 5,600,000 cubic yards annually, and that the work be done by hired labor and United States plant at a cost of $150,000 annually.

(*k*) That the new work be completed in not to exceed four years, with a first appropriation of $850,000, the remaining cost to be furnished in three annual installments of $300,000 each, these amounts including maintenance during the period of construction at $150,000 per year for the harbor channel, and $15,000 per year for that across the bar, making the total cost of improvement in accordance with (*e*), (*f*), (*g*) and (*h*), (*i*), (*j*) roundly $1,750,000.

(*l*) That no work be done until some competent and authorized local agency has made and presented the plans and arrangements for further transfer and terminal facilities, and it has been made certain that the acceptable plan will be pressed to completion at a suitable rate of progress.

C. Keller,
Lieutenant Colonel, Corps of Engineers.

[First indorsement.]

Office of Division Engineer, Gulf Division,
New Orleans, La., January 26, 1916.

The Chief of Engineers, United States Army.

1. Forwarded.

2. The present and prospective importance of this port are such as, in my opinion, to warrant some increase in depth and width of approach channels, conditioned upon extensive improvement of the present terminal facilities, including port regulations, and limited by the consideration that the cost of maintaining the improved channels should not exceed the benefits to be derived therefrom. It has been demonstrated that the powerful and efficient dredges employed by the Government in maintaining the present channel have been able to maintain it, in spite of large annual shoaling, at a cost that is not excessive in comparison with the commerce concerned. The district officer's estimate of the increased cost for maintaining a 30-foot channel in the bay appears a liberal one, and I believe that the actual cost would be considerably under this estimate.

3. As to the channel across the bar at the Gulf entrance to the bay, it is stated in the report that the local interests desire a depth of 35 feet. At present the project depth on the bar is 3 feet greater than that in the inner channel. In investigating the question as to how much more depth is needed on the bar than in the river channel, it has been learned that since the bar project was completed, in March, 1914, there has been no complaint in regard to vessels that were able to pass through the inner channel striking on the bar. Since the date of the above report the harbor master and pilots have, I am informed, admitted that a 3-foot excess depth over the outer bar was sufficient. It appears, therefore, that the same excess depth on the outer bar as at present is sufficient, and in my opinion is advisable.

4. I have examined the physical conditions at this harbor, the present and possible terminal facilities, and the data obtained by the

survey and by the records of original and maintenance dredging; and concur in all the recommendations of the district officer as stated in paragraph 26 of his report.

J. C. SANFORD,
Colonel, Corps of Engineers,
Division Engineer.

[For report of the Board of Engineers for Rivers and Harbors on Survey, see page 3.]

LETTER OF THE MOBILE CHAMBER OF COMMERCE AND BUSINESS LEAGUE.

MOBILE, ALA., *September 14, 1915.*

DEAR SIR: I wish to call to your attention the importance of the order of the Interstate Commerce Commission, effective November 1, 1915, obtained by the Chamber of Commerce of Mobile and the Mobile Cotton Exchange, directing railroads operating in Tennessee, Mississippi, Alabama, and Georgia to so revise their tariffs as to remove their discriminations against Mobile and in favor of Savannah and Pensacola. This order was obtained after attention of the Interstate Commerce Commission had been called to the fact that their opinion to become effective April 1, 1915, had not been obeyed, copy of letter pertaining to this being inclosed.

The effect of this order will be very far reaching and will cause joint rates and through rates to be published to Mobile from sections where formerly there were no rates in effect via Mobile, and will also cause a discontinuance of discriminatory rates and practises whereby in the past cotton was forced through Savannah, even though the mileage was more favorable to Mobile. In more than half of the cotton-producing sections of Alabama heretofore, either by having no concentration privileges, or no joint through rates, or by publishing a lesser rate for a longer distance, cotton was forced through Savannah to the detriment of Mobile. All of these discriminations and also the terminal situation are corrected by the opinion and order of the Interstate Commerce Commission. The correction of the terminal situation is brought about in the order by requiring the publication of a uniform 3-cent charge for the service to all wharves alike, thus giving open shipside delivery and making Mobile an open port.

To give an idea of the change in territory from which Mobile could heretofore compete, and which after November 1 she will be able to compete, we explain below our opinion of the effect of the decision. Now we can compete on about one-third of the cotton produced in Alabama on nearly equal terms, or about 500,000 bales, in Mississippi on less than half the growth or about 500,000 bales, in Florida about 30,000 bales, in Memphis territory only on proper cotton (cotton drayed into Memphis or arriving by river) and cotton from west of Memphis and a limited portion of Tennessee. In all we should say we can compete on 1,600,000 of which, of course, a large part necessarily is shipped to the East and to the Carolina mills. The effect of the new order would put us in a position to be competitive on practically the whole Alabama crop, about 1,500,000 bales, on fully one-half of Mississippi or 650,000, on all of Tennessee or about 400,000 bales, Florida about 30,000 bales, in the Memphis territory on all receipts or 1,200,000, in Georgia about 100,000 bales—total of about 3,800,000. We believe that it opens the bars to our being competitive on more than twice the amount of cotton upon which we were heretofore competitive. In connection with this we wish to call to your attention that the increasing trade in cotton with the Orient, when shipping is again normal, will undoubtedly turn to the Gulf ports and through the Panama Canal, as the nearest and cheapest route. No port will be better adapted to supply their wants than will the port of Mobile, as Orient purchases in the eastern cotton belt have in the past consisted most largely of Alabama and the eastern half of Mississippi cotton, the sections that we can best serve.

Another rate adjustment of great importance to Mobile is that the Louisville & Nashville has published, effective August 20, 1915, reduced rates on iron articles from the Alabama mineral district to Mobile when destined to the Pacific coast via the Panama Canal.

The former adjustment was that rates from the Birmingham district to Mobile were the same as from Chattanooga and the Tennessee district to New

York, and rates to Savannah and other south Atlantic coast points were lower than to Mobile.

The new adjustment of the Louisville & Nashville Railroad reduced pig iron carload, from all Alabama furnaces to Mobile from $2.75 to $1.75 per ton of 2,240 pounds. It reduced the rate on cast-iron pipe from all Alabama furnaces to Mobile from $3 to $2 per ton of 2,000 pounds. It also reduced the rate on bar, band, boiler, and about 75 other manufactured iron articles from the Birmingham district from 16 cents to 12 cents per hundred pounds.

The latter rate is a differential of 4 cents per hundred pounds under the current New Orleans rate and is the lowest rate from the Birmingham district to any port.

It can readily be seen that when ocean tonnage again becomes normal it will enable the iron industries to send their pig-iron products through this port.

Yours, truly,

R. G. Cobb, T. M.

Lieut. Col. Chas. Keller,
Corps of Engineers.

LETTER OF THE MOBILE CHAMBER OF COMMERCE AND BUSINESS LEAGUE.

Mobile, Ala., *July 9, 1915.*

Dear Sir: Please refer to your letter to Mr. R. G. Cobb regarding cotton rates to Mobile in accordance with case 5899.

Up to the present time no tariffs or supplements have been received from any of the carriers publishing the revised rates or terminal charges. We inclose copies [1] of letters from freight traffic manager of the Southern Railway and the general freight agents of the Atlantic Coast Line, Illinois Central, and Seaboard Air Line roads, from which it appears that the carriers do not intend to promptly publish rates in accord with your decision.

Pages 276 and 277 of your decision clearly indicate that equitable rates should be published to the compress point, also to publish proper comparative rates as between Mobile and Savannah, mileage considered.

Southern Railway, referring to Freight Traffic Manager Green's letter, copy attached. There have been no changes at all in the rates to Selma and other compress points since November 30, 1914, date of the decision. To give several examples of through rate: From Birmingham to Savannah, 459 miles (short-line mileage, 425), the rate has been advanced from 45 to 47, while rate to Mobile, 272 miles, remains unchanged (45 cents). From Hooper, Ga., to Savannah, 360 miles, the rate of 45 cents is unchanged, while rate Hooper to Mobile, 331 miles, has been reduced from 50 to 48 cents. From Weems, Ala., to Savannah, Ga., 453 miles, the rate has been advanced from 45 to 47 cents, while rate to Mobile, 276 miles, has been reduced from 50 to 45 cents. (See p. 277 of decision.)

The above are only a few of the points taken at random from a tariff Mr. Green claims is in line with docket 5899. Naturally we disagree with him.

Due to difference in steaming time to Liverpool from Savannah and Mobile, Savannah enjoys an ocean differential under Mobile in normal times of about 7 cents per 100 pounds, and also a slightly favorable differential in insurance.

We feel that nothing is being done by the carriers to comply with the decision of the commission effective April 1, 1915, and judging from the inclosed letters from the railroad officials we expect no favorable action without the active cooperation of the commission. We are certain that you, with a true knowledge of the situation, will agree with us that the carriers have so far ignored the expressed decision of the commission in this case.

We respectfully ask that you advise us just what action we as complainants should take under the circumstances.

Yours, respectfully,

M. D. Kahn,
Chairman, Joint Freight Commission.

Hon. C. C. McChord,
Chairman, Interstate Commerce Commission,
Washington, D. C.

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[1] Not printed.

LETTER OF MOBILE LINERS (INC.).

MOBILE, ALA., *October 29, 1915.*

DEAR SIR: Referring to conversation sometime ago, we beg to advise that owing to deeper draft at Pensacola the following vessels went there instead of coming to Mobile this past summer:

Steamship:	Shillings.
Napierian, May, 27 feet 7 inches, rate	200
Norwegian, June, 28 feet, rate	200
Nestorian, June, 28 feet 9 inches, rate	200
Median, July, 27 feet 8 inches, rate	150
Nestorian, August, 29 feet 4 inches, rate	180

Rates quoted are shillings per standard of 165 cubic feet pitch-pine timber. Draft of all the vessels mentioned, if at Mobile, would have been 6 inches deeper owing to Mobile being fresh water, whereas Pensacola is salt water.

Mobile rates at same time were:

Steamship:	Shillings.
Nubian—	
May, 27 feet 4 inches, rate	205
July, 27 feet 11 inches, rate	205
Orubian, August, 26 feet 1 inch, rate	200

Both the *Orubian* and *Median* drew more water than owners liked in a 27-foot channel and put these boats in the class of dangerous risks as compared to safe risks at Pensacola at even greater drafts. After owner starts booking for a certain position it is often necessary to change vessel from one for which bookings were intended, substituting one of deeper or less draft. Ability to book Pensacola without having to worry about draft on any boat makes them more willing to accept business and take a lower rate from Pensacola than from Mobile. This accounts for fact that from March to October Pensacola loaded timber on 13 boats, as compared to Mobile's 7 (two of which really should not have loaded at Mobile, *Nubian*, May and July). Take, for example, July, when Pensacola loaded three boats at rates ranging from 150 to 200 shillings, as compared to one boat which loaded at Mobile at 205 shillings and which boat would never have come to Mobile had owners had any smaller vessel available to carry Mobile bookings.

Anything you can do to assist Mobile in getting a 30-foot channel will be sincerely appreciated by Mobile shipping and steamship interests. At present for timber business on vessels handled by us, Mobile, owing to lack of 30 feet of water, is in the class of dangerous ports and is at a disadvantage because if there is any distress room available, Mobile is included because it is usually the big boats that get in distress on a slight movement and a big boat can not load to her full capacity at Mobile.

Lack of depth also puts Mobile at a terrible disadvantage in case of coaling vessels when compared to Pensacola and practically annuls advantage she has through being able to barge coal from Birmingham. Of the vessels which do drop into Pensacola to coal, and which would drop in at Mobile to coal, the great majority of vessels begin loading elsewhere and, therefore, are deep draft. Giving sufficient water to barge Birmingham's products to Mobile and insufficient water from Mobile to outer bar is just like equipping a railroad for heavy engines and then leaving part of the line with bridges and roadbed too light to take heavy engines. Of course, the weight of equipment that could run over the railroad would be limited by the light bridges and roadbed, and the advantage to be gained from heavy equipment would be lost.

Yours, truly,

S. A. LE BLANC, *Manager.*

Lieut. Col. CHAS. KELLER,
Corps of Engineers.

LETTER OF THE MOBILE COTTON EXCHANGE.

MOBILE, ALA., *January 10, 1914.*

DEAR SIR: As we understand data is being obtained by your office as to the necessity of Mobile having at least a 30-foot channel, the Mobile Cotton Exchange wishes to emphasize the fact that Mobile is at a disadvantage with her competitors—New Orleans and Pensacola on the Gulf; Brunswick and Savannah on the South Atlantic coast—as to the handling of cotton from interior competitive points in Alabama.

Thirty feet of water for Mobile would have the following effect:

First. It would enable the steamship lines operating out of this port to bring the larger and more economically operated steamers of the Gulf trade to Mobile to load with a part dead-weight cargo, such as logs, staves, and timber, completing the cargo of these large steamers with cotton to foreign markets.

Second. By the operation of these larger steamers, Mobile would enjoy the lowest ocean rates obtainable in the Gulf trade, inasmuch as the large steamers could not only load, but they could take bunker coal as well at Mobile, instead of having to incur additional expense of shifting to another port to complete cargo and take bunker coal.

Third. By loading a complete cargo at Mobile, steamship lines would be saved the penalty of one-sixteenth of 1 per cent, which is charged when a steamer loads cotton cargo, and is forced on account of lack of water at Mobile to go to another port to complete loading; therefore the interior shipper using this port could with a deeper channel and larger steamers obtain more favorable ocean rates, thus receiving a larger net return for his goods than he has been able to obtain in this district in the past.

We wish to call your attention to the fact that during the past year, money was subscribed by the citizens of Mobile for the purpose of investigating the rail rates on cotton from interior Alabama points to Mobile, as compared with other ports. Also to correct certain practices on the part of some of the railroads at this port as to issuance of through bills of lading. The investigation showed a most remarkable state of affairs—that rates from points in Alabama to the port of Mobile are as high as and in some cases higher than to South Atlantic ports, although the South Atlantic ports were very much farther and in some cases almost twice the distance. It was also found that there were no joint through rates from a great many points in Alabama to Mobile, and thus no way of shipping the cotton to Mobile. This condition grew out of the fact that certain lines, such as the Central of Georgia, for example, operated from Birmingham to the Atlantic coast and had no line from Birmingham to Mobile. The Interstate Commerce Commission has been asked to install the proper joint through rates and correct the practices that have been detrimental to the shippers through the port of Mobile. The railroads, of their own accord, have been correcting many of the rate discriminations and some of the adverse practices since this action was taken. In the case of one railroad alone there has been a movement so far, for the present season, of over 80,000 bales of cotton on through bills of lading, while over this same railroad, during the whole of last season, there were only 300 bales, and our total receipts of cotton to date are about 160,000 bales in excess of the receipts for the same period last year.

Failure to promptly obtain through bills of lading and the necessity which has existed in the past of shipping under local bills of lading, resulted in delay to the cotton and represent an average loss per day in interest alone on each car, averaging, say, 50 bales to the car, of about 50 cents. Since the 27-foot channel has been available for eight months of the year 1913, there has been a material increase in the exports over the same period last year, thus showing that this port, just like any other port, responds quickly, in increased business, when the channel is deepened.

Very respectfully,

E. D. LEDYARD,
President Mobile Cotton Exchange.

Lieut. Col. CHAS. KELLER,
Corps of Engineers.

LETTER OF MESSRS. PAGE & JONES.

MOBILE, ALA., *December 18, 1913.*

GENTLEMEN: As requested by your office, we wish to emphasize the fact that Mobile should have 30 feet of water to accommodate the larger type of steamers that are being operated in the Gulf, which steamers should be able also to include the port of Mobile, which latter port is developing so much traffic at the present time. In selecting steamers for Mobile loading care must be taken to get only such boats as can go to Mobile and load out upon the present depth of water. We understand that within a few months the channel will be completed to 27 feet, and this will accommodate a great many more of the steamers, but, of course, will not accommodate all of the large size and deep-draft steamers that come into the Gulf. To give you a concrete example of how the depth of water in a channel affects the port, I would state the fact that the Atlantica Sea Navigation Co., of Budapest, Hungary, sent their representative to the Gulf to investigate conditions. This line, which owns steamers of a very large capacity, operates to the Mediterranean ports. There is no question as to these steamers being able to operate out of New Orleans, but the manager of this line, on his trip to Mobile, is confronted by the fact that this port would only have 27 feet of water under the most favorable conditions of tide, whereas the steamers of this line would have great difficulty getting in and out with heavy cargoes at such a depth. The steamers of this line are 5,000 or more ton freighters of the latest improved type. Our firm handles quite a lot of business from the port of Mobile and naturally we would like to be put in the position of being able to accommodate our shippers at that port by chartering and sending to Mobile any of the larger type steamers operating from the port of New Orleans, also to induce the manager of the Atlantica Sea Navigation Co. to send the steamers of this line to Mobile for the quantities of staves, hardwoods, lumber, etc., offering from Mobile to Mediterranean ports. Mobile is affected to a considerable extent during the winter months by the fact that there is not a regular tide; that the tide is affected by the winds, which at unfavorable times prevent the tide from coming up at all. A port handling as much business as Mobile should have ample water to take care of all of the deep draft steamers now operating in the Gulf, and the size and draft of the steamers seems to be steadily increasing.

Yours, truly,

PAGE & JONES.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala.

LETTER OF THE HARBOR MASTER.

MOBILE, ALA., *December 20, 1913.*

DEAR SIR: As harbor master of the port of Mobile, I take the liberty of addressing you on the subject of the necessity for 30 feet of water in our channel.

All of the steamship lines of this port have been in the past, and will be in the future, more or less affected by the drop in the water growing out of the north winds which blow so continuously here in the winter season. When we had 22 feet 6 inches in our channel a vessel wishing to load at this port to this maximum draft had, of course, to take into account the lack of water during the northers when there is no tide, and when the water shallows from 2 to 4 feet, say an average of 3 feet.

This same condition of water affects our shipping now that the boats can load to the greater draft of 25 feet, or to 25 feet 6 inches, and will also affect our port when we have 27 feet depth.

It is not wise, in many cases, for steamers to load as deep as they do, but the necessities of the steamship business force the steamship lines to bring the deepest draft vessels possible to this port, and naturally the steamship lines do not wish to let the steamer leave the port without taking on every bit of cargo that it is safe for the steamers to take and still get to sea. The owners of the steamships, of course, do not want their steamers loaded until they are dragging bottom; further, there is always the danger when so deeply loaded of touching a sunken log or something of similar character lying on the bottom.

If we have 30 feet of water in our channel, even though the steamers are affected by the north winds of winter, the majority of the boats engaged in the Gulf trade will be able to come to this port, load and get away without delay or accident. It would be only some of the very large and deepest draft steamers operating in the Gulf which might be affected during the time the north winds were blowing if we had a 30-foot channel, as with the 3 feet drop this would leave 27 feet. Often these very large steamers crowd very close to the 30-foot mark at New Orleans and Galveston.

We have had some accidents in Mobile after the steamers were loaded and of course there is always a possibility of more accidents in the future where such a large proportion of the steamers are loading deeply, and in consequence getting so near the bottom of the channel. The expense of one of these accidents is so great and produces such an impression upon the underwriters and upon the owners of the large steamers operating in the Gulf that it is a source of considerable worry to the shipping interests at this port.

Until Mobile has as deep a channel as New Orleans, our principal competitor on the west, or Pensacola, our principal competitor on the east, Mobile will always be at a disadvantage. Even with the completion of the locks and dams in our upper rivers and the fact that we might have the cheapest coal on the Gulf, Mobile would not be able to furnish regularly this coal to the commerce of the Gulf until the channel was deepened to 30 feet, to permit the heavily loaded steamers of 27 feet or more loading at New Orleans and Galveston to stop by this port and coal at all conditions of tide.

It was only this week that Norton & Sons, of New York, requested me to write them the deepest draft that steamers can safely load at Mobile. They have one due in January and one in February, and the latter they desire to load deeper than 25 feet, which is all that a steamer should safely count upon at this time.

Also to-day another steamship agent requested information about the channel, and asked if he could load a steamer to 26 feet 6 inches.

Yours truly,

THOS. P. NORVILLE, *Harbor Master.*

UNITED STATES ENGINEER OFFICE,
Mobile, Ala.

LETTER OF THE MOBILE COAL CO.

MOBILE, ALA., *December 17, 1913.*

SIR: As requested, we beg leave to state that in our opinion the business of this port is greatly suffering for the want of a deeper channel from the wharves of Mobile to the Gulf. In the present state of our channel, permitting vessels to load only down to 25½ feet (even at that draft having to wait for favorable tide), it is necessary for those handling steamers here to secure small steamers, and it is well known that a small steamer can not carry freight as economically as a larger steamer. The tendency of the last few years has been, and now is, to build steamers for doing general business of a large capacity, usually drawing in the neighborhood of 30 feet.

Mobile is hampered and losing business daily by reason of its channel not having sufficient depth for the modern business requirements. It is no unusual thing for vessels to come here and be forced to leave without taking on their full cargo, and some of the vessels that do come here for loading find themselves unable to take their bunker coal here on account of their draft not being sufficient to take cargo and bunker coal both; they will load cargo here down to the draft permitted (25 or 25½ feet), and then go into another port to fill up their bunkers with coal.

It is of the greatest importance to Mobile and all doing business here, including the railroads and steamboats on the upper rivers, that we should have a channel sufficiently deep to permit steamers loading down to 30 feet.

Very respectfully,

A. C. DANNER, *President.*

UNITED STATES ENGINEER OFFICE,
Mobile, Ala.

LETTER OF THE ELDER DEMPSTER LINE AGENCY.

MOBILE, ALA., *January 10, 1914.*

DEAR SIR: We are placed at a great disadvantage as compared with the other principal Gulf ports for the reason of our not being able to handle the same class of vessels as do the other ports. We at nearly all times have steamers either in the Gulf or on the way to the Gulf considerably larger than those which we have loaded at Mobile, and which could and would come to Mobile if we were not restricted as to draft. Only recently we were asked if we could load the *Monarch*, a steamer of 7,355 tons gross, loaded draft about 29½ feet. We had sufficient cargo for this steamer, but the question of draft kept her away, cargo consisting of logs, lumber, rosin, and cotton putting her very close to her load line. Most of the steamers handled by us are charters, and if more water was available and we could load some of the larger type, as New Orleans and Galveston do, we could make slightly better rates, as a larger steamer is much more economical than what we are now using. During the past year we have only had two vessels drawing over 25 feet when sailing, the steamship *Frankmere*, sailing August 15, and the steamship *Tronto*, October 5. The *Frankmere's* draft was 25 feet 6¼ inches and the *Tronto's* 25 feet 9 inches. The load line of both of these vessels was several inches deeper, and both would have taken more cargo if they could have been loaded deeper. Since the departure of the *Frankmere* we have been instructed by our head office in Liverpool that they do not consider it safe to load vessels of this type again as deep as she was loaded. They write: "Owners have written us that they do not consider Mobile a safe port for a vessel of the *Frankmere's* draft." The *Frankmere* made another trip to the Gulf, sailing a few weeks ago, loading at New Orleans. We expected to have her at Mobile again, but the owners would not permit of her coming here.

Several months ago our people made a booking of 8,500 tons of pig iron with the option of loading this iron at either New Orleans or Mobile. We fully intended to load this cargo at Mobile, as the rail rate was lower than into New Orleans, and we would get an increase in the ocean rate; but, again, on account of so much dead-weight with wood goods and cotton, we had to give up the idea of handling any of this iron through Mobile. As a matter of fact, we have to be very careful in the selection of cargo for the majority of our Mobile vessels. Vessels loaded during the winter months with cotton show less draft than steamers loading at other seasons, when cotton is not available and dead-weight cargo is used instead.

Yours, truly,

ELDER DEMPSTER LINE AGENCY.

Lieut. Col. CHAS. KELLER,
Corps of Engineers.

LETTER OF THE MOBILE & OHIO RAILROAD CO.

MOBILE, ALA., *December 22, 1913.*

DEAR SIR: I desire to emphasize with all of the force at my command some of the conditions which make necessary an increase in the depth of the channel leading from Mobile to the lower bay to 30 feet and an increase in the bottom width to 300 feet and an increase in the depth of the channel across the outer bar to 35 feet, with 500 feet bottom width.

I am informed by the harbor master at Mobile that the present maximum draft to which vessels are permitted to load is 25 feet, and this draft is even further restricted if the conditions are unfavorable.

The tendency of shipowners to-day is to largely increase the tonnage of their vessels. The present average loaded draft of ocean steamships is 29 feet, and the demands of commerce constantly call for deeper draft vessels and deeper ports to accommodate them. It is, therefore, the tendency of maritime traffic to seek the ports with sufficient depth of water to permit the unobstructed entrance and departure of the usual run of vessels. To operate a steamship economically and to secure the best results it is necessary to load so as to utilize all available capacity and bring all vessels down to their marks. This is not possible at Mobile with the present depth of water, as is exemplified by the fact that steamship lines now operating from this port can send here only such vessels as are available by reason of their small size and limited draft. It is at present often the case that after taking their cargoes here vessels must be sent to deeper ports for coaling, the limited depth of water at Mobile preventing the taking on of both cargo and bunker coal necessary for the voyage at this port. On practically every voyage of the Munson Steamship Line from Mobile to River Platte ports of South America these vessels must go to Pensacola to complete their deck loads of lumber, not because the lumber is not obtainable at Mobile but because there is not sufficient depth of water at this port to enable them to complete their cargoes here.

The commerce of Mobile has immediately responded to every increase which has been made in the depth of water in its dredged channel leading to the

Gulf, and its future development rests largely if not entirely upon a further increase in depth sufficient to accommodate the largest seagoing vessels.

The Mobile & Ohio R. R. Co. will have an arrival at its docks on January 5 of a tank steamer loaded with 8,000 tons of blackstrap, a residuum of the sugar industry of Cuba, used in making cattle food. This vessel draws 26 feet of water and can only pass up the channel under a special permit, on account of its limited depth. This is the pioneer ship of a line that has been made barely possible by the present depth of water, and it will this year bring in at least 100,000 tons of this important product.

The territory tributary to Mobile furnishes varied classes of productions which are seeking foreign markets in increasing volume from year to year, and draws in an important part of the imports of this country. The entire territory measured by a line drawn midway between the Mobile & Ohio Railroad and the Illinois Central Railroad and a north and south line running through Atlanta, Ga., is tributary to this port. The vast productions of cotton in this territory should seek a market through Mobile. As you know, cotton is our greatest money crop and enables the United States to maintain its balance of trade with the rest of the world.

Mobile is the natural port of Birmingham, which is rapidly becoming the greatest iron center of this country, and exports of dead-weight cargo must be in the ships of the greatest draft. The nearness of Mobile to all of the great distributing points of the West, as compared with other ports, is graphically shown by the following table:.

	Distances from—			
	St. Louis.	Chicago.	Des Moines.	Kansas City.
	Miles.	*Miles.*	*Miles.*	*Miles.*
Mobile	647	920	1,059	868
New Orleans	699	921	1,045	878
Pensacola	770	909	1,130	972
Galveston	846	1,138	1,058	840
Savannah	871	1,026	1,245	1,161
Baltimore	932	797	1,073	1,209
New York	1,054	912	1,270	1,310

The management of the Mobile & Ohio Railroad Co. has played no unimportant part in the establishment of the lines of steamships now existing between Mobile and the ports of Central and South America, Cuba, and those of the Lesser Antilles, as well as the ports of Europe. In carrying on the work of expansion of the business of Mobile it has been necessary for the officers of this company to keep in close touch with all of the great steamship interests of the world, and for this reason we are quite familiar with the difficulties which have heretofore existed at Mobile on account of the lack of depth of water sufficient to accommodate ships of the greatest draft.

The opening of the Panama Canal will soon greatly intensify this necessity.

The officers of this company are now in negotiation with some of the largest import and export companies in the world. The firm of W. R. Grace & Co., of New York, is largely engaged in the importation of nitrate of soda from South America to this country, and the exportation of merchandise. This firm operates vessels of large carrying capacity and deep draft, too deep to enter the port of Mobile at the present time.

The importance of the nitrate of soda importations into this country can easily be seen by reference to the Monthly Summary of Commerce and Finance of the United States, issued by the Bureau of Foreign and Domestic Commerce, for the month of September, 1913. The importations of nitrate of soda is therein shown to have been from Chile alone, for the 12 months ending September 30, 1913, 524,831 tons, with a value of $18,292,322. Fully 75 per cent of this vast tonnage is distributed to points which could be advantageously reached through the port of Mobile. All of these facts are well known to W. R. Grace & Co., with whom we are in close negotiation, and we are only estopped from attracting this business via Mobile by the lack of depth of water.

We are now also in correspondence with the American-Hawaiian Steamship Co., which owns and operates the largest fleet of American vessels afloat, with a view of establishing steamship service, after the completion of the Panama Canal, between Mobile and Pacific coast points. Seventy-five per cent of the vessels operated by the American-Hawaiian Steamship Co. can not enter the port of Mobile with a 27-foot channel. These vessels could, and undoubtedly would, come to Mobile on account of its advantageous location had we a channel of 30 feet in depth. We have positive information that such a service will be established in connection with some Gulf port after the canal is opened, and this port would be Mobile should the depth of water we have to offer accommodate these vessels.

We have had similar negotiations with important Japanese lines, and are met with the same difficulty of depth of water.

This port is in competition with the ports of New Orleans, Galveston, Pensacola, Charleston and Savannah, all of which can accommodate vessels of much greater depth than 27 feet will permit us to serve.

I have been connected with the Mobile & Ohio Railroad Co. for 36 years, and for many years have occupied a position in its management, and have had a part in all of the maritime development of the port of Mobile for the past quarter of a century. From my own personal knowledge I can unhesitatingly state that we have pressing need for 30 feet of water in our channel leading to the sea, and you can feel certain that if you give the weight of your recommendation to this project that you will play your part in creating a set of conditions by which Mobile will within a short time become one of the great ports of the world.

Yours, very truly,

R. V. Taylor,
Vice President and General Manager.

Lieut. Col. Chas. Keller,
Corps of Engineers.

LETTER OF MESSRS. JAMES GIBBONEY & CO.

Mobile, Ala., *December 17, 1913.*

Dear Sir: As we understand recommendations are now being considered for increasing the depth of water in Mobile Channel to 30 feet, we beg to submit such facts as result of operating steamers in and out of this port as will, in our opinion, show a necessity for a greater depth of water than 27 feet, under our present project.

Aside from the wonderful increased growth of our commerce, entitling Mobile to rank as one of the first-class ports of our country, we are at the present time confronted with such physical conditions, in the operating of steamships in and out of this port, as to make a depth of 30 feet in our channel an absolute necessity.

It is a known fact that during the winter months we have a fall in our tide of at least 3 feet, restricting the depth of water in the harbor and channel accordingly. As a result of this, the steamship *Isle of Jura*, operated by the Munson Steamship Line from this port to South America, was delayed 24 hours after being loaded and ready to sail on account of the restricted depth of water in the channel, steamer being loaded to a depth of 24 feet, necessarily had to wait for the most favorable tide. While of course the increased depth of 27 feet from the present time would remedy the trouble and delay sustained by this vessel, it must be considered that larger vessels have a deeper draft, and will be ordered to this port by the steamship companies operating from this port when we have a greater depth of water in our channel to justify the larger and deeper draft boats.

Another instance of our steamers being delayed was on February 5, steamship *Ormley*, loaded with full cargo at Mobile for South American ports, had to stop at Pensacola for taking on bunker coal for the voyage.

While it may be contended the increased depth of 27 feet when completed would suffice to properly take care of the commerce of this port, based on the draft and type of boats now being operated, it frequently happens the steamship companies doing business out of the port designate such boats for calling at Mobile as can comply with the restricted depth of water at that port.

In comparing the size and types of steamships operating from Mobile at the present time with the size and draft of vessels operated prior to the increased depth in our channel, it will readily be seen it is the policy to increase the size and draft of boats, and this will be the policy pursued by steamship companies even after we have the 27-foot project completed.

The Munson Steamship Line, operating as they do a very large fleet of steamers, select such boats for loading at Mobile as can comply with the draft of water at our port, and this will be the case in designating boats to load at Mobile after we have the 27-foot project completed. The Munson Line, as well as other steamship companies operating from this port, should be placed in position to operate the same size and draft boats as competitive companies operate from other ports competing with them for South American business.

We frequently have had complaints from captains of our steamers, when loaded to within a few inches of the maximum draft, claiming that the close proximity of the bottom of the channel to the bottom of the ship has the effect of choking the pumps and otherwise seriously interfering with the operation of the ships, and is, of course, also dangerous. Thus in loading to within a few inches of the 27-foot depth we will have the same complaint, and it can only be eliminated by an increased depth to 30 feet of water in the channel, which we should by all means have, and which draft should accommodate the majority of the heavy freight-carrying steamers operating from the Gulf ports and Mobile for some time to come.

Respectfully, yours,

JAMES GIBBONEY.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala.

LETTER OF THE JOINT RIVERS AND HARBOR COMMITTEE.

MOBILE, ALA., *December 29, 1913.*

DEAR SIR: The joint rivers and harbor committee of Mobile submit the following facts and reasons as to why Mobile should have additional depth and width of channel to properly accommodate both the present and the future commerce of this port.

Conditions existing under present channel and conditions that will exist with completion of 27-foot channel:

First. Mobile has reached her present growth as a port—ranking third on the Gulf and tenth in the United States, in amount of net registered tonnage entered and cleared in foreign trade, also tenth in the value of exports and imports, out of a total of over 70 ports—in spite of her serious handicap of lack of water in the channel, as compared with the deeper channels of competing South Atlantic and Gulf ports.

Second. The steamship lines operating out of Mobile have had to carefully select their steamers as to draft, not only during the period of the 23-foot channel, but also since the partial completion of the 27-foot project, which has permitted for some months a loaded draft of 25 feet 6 inches under favorable conditions of tide and weather.

Third. As is clearly shown by the letters of the agents of the Munson Line, Elder-Dempster Line, Mobile Liners (Inc.), by the letters of Mr. T. P. Norville, harbor master; Mr. R. V. Taylor, vice president, Mobile & Ohio Railroad Co.; Mobile Coal Co., Page & Jones, and others, this same selection of steamers, as to draft, must be made with the completion of the 27-foot channel, and the larger type of steamers operating in the Gulf and which would come to Mobile can not possibly come with a 27-foot channel.

Fourth. Mobile is handicapped, as is well known to our shipping interests, by the uncertainty of a tide during the winter or busy season when the north winds lower the water in our channel. The difference between our lowest water in a norther and our highest water with the south wind blowing being over 4 feet and our harbor master, upon whom rests the responsibility of permitting the maximum loading of steamers, finds an average difference of 3 feet between the water we should have and that left by northers.

Fifth. The fact that the port of Mobile does not have 30 feet of water—like the Gulf ports of Pensacola, New Orleans, Galveston, Texas City, and Port Bolivar—will and does prevent the coming of new lines to Mobile (although Mobile possesses all the advantages in other respects), such as a new service to the Mediterranean, referred to by Page & Jones, also a new service from the Pacific coast upon the opening of the Panama Canal and a new line of steamers with nitrate of soda from Chile, as referred to by Mr. R. V. Taylor.

Sixth. The loss in time and additional port charges of steamers leaving Mobile to complete deck loads and take on bunker coal elsewhere, for example, as explained by James Gibboney & Co. and Mr. R. V. Taylor as to the Munson Line, which completed so many steamers in their South American service at Pensacola; also steamers of Mobile Liners (Inc.), forced to other ports to complete loading, is a great expense and, this loss must continue until all of the larger steamers requiring at least 30-foot depth of water, can complete both loading and bunkering at Mobile.

Seventh. The competition of ports necessitates the loading, at Mobile, of steamers to the maximum draft possible to leave the port and this loading so near the bottom has resulted, in the past, in accidents as is explained by Mr. Murray Wheeler, Lloyd's agent. Further, since the 25-foot 6-inch depth was permitted this same danger is emphasized by complaint received by Elder-Dempster Line from owners of the steamer *Frankmere* (which loaded out to 25 feet 6½ inches) "that Mobile was not a safe port." The same complaint and unfavorable criticism by steamer owners has been common in the past and will continue with 27-foot depth of channel, for upon this depth the steamship lines at Mobile must load, as deeply as possible, the larger type of steamers coming to Mobile. Nothing but a 30-foot channel, and a parity with competing ports, will obviate the risk of heavy loading and make Mobile an absolutely safe port, in the opinion of underwriters, shipmasters, and owners.

Eighth. Mobile not only suffers because the larger size steamers of the Gulf can not come to our port and because many of the smaller-size steamers that do load at Mobile must go elsewhere for part cargo and deckloads, but Mobile, in addition, also loses the sale of bunker and other coal, although Mobile is the cheapest port for coaling and the logical port through which the vast coal supply of Alabama should and could most economically pass.

WHY MOBILE SHOULD HAVE 30 FEET OF CHANNEL DEPTH.

First. Because the largest Gulf steamers and the most economically operated freight steamers would come to Mobile and guarantee the port the lowest freight rates obtainable in the Gulf, such, for example, as the class of steamers out of New Orleans during year 1913, loading to draft as shown below:

Steamer.	Draft.		Steamer.	Draft.	
	Ft.	*in.*		*Ft.*	*in.*
Joan D'Ark	28	0	Saxonia	27	7
Prometheus	27	9	Californian	27	3
Custodian	28	0	Excelsior	27	8
Victorian	30	6	Phoebus	30	0
Indian	30	6	Nessian	27	6
Monarch	29	0	Maartensdijk	29	0
Cestrian	29	0	Rathlin Head	28	8
Commanchee	27	9	Armenian	30	6
Bulyssis	27	8	Meltonian	27	8
Wayfarer	28	3	Gorredijk	29	2
Nubian	29	9	Colonian	28	3
Andijk	28	11	Atlantian	29	8
Oxonian	28	4	Kansan	29	5
Hesperus	28	0	Richmond	30	3

Some of these steamers loaded as many as four times at New Orleans during the one year, nearly all of them loaded two or three times, so we take the deepest draft of the several trips.

Second. Because a port the size of Mobile—tenth in rank in the total value of exports and imports, also in net registered tonnage entered and cleared in the foreign trade, as shown by Department of Commerce and Labor for year June 30, 1912—should have 30 feet of water and be upon a fair competitive basis with such competing ports as New Orleans on the one side and Pensacola, Savannah, and Brunswick (all having 30 feet or more) on the other; also should have at least the same depth as smaller Gulf and South Atlantic ports like Texas City, Port Bolivar, Pensacola, Key West, Fernandina, Jacksonville, Brunswick, Charleston, etc.

Third. Because the opening of Alabama's river system, containing over 1,500 miles of navigable streams, will influence the movement to Mobile, by self-propelled barges or other means of water transportation, of vast amounts of hardwood timber, cotton, cement, limestone, iron products, and coal from the richest territory in natural resources possessed by any section of the South (one city alone, Birmingham, generating more tons of freight per year than does the entire State of Georgia, and the Warrior River mineral district possessing even greater resources than the Birmingham district).

Fourth. Because shippers in territory adjacent to Mobile and those located upon our river system should enjoy the lowest freight rates obtainable on the Gulf, and the waste, unavoidable where there is a restriction in the size and class of steamer tonnage possible at a port, should be eliminated.

Fifth. Because the loss in time of steamers, in changing port for remainder of cargo and for bunker coal, is a waste that should be saved to the shipping interests using our port.

Sixth. Because the millions spent by the Federal Government in making the Warrior River iron and coal deposits available, by river transportation and at the lowest cost to the commerce of the world, would be nullified to a large extent if there was a lack of deep water at the port of Mobile, where the large steamers must get this cargo.

Seventh. Because the future movement of such heavy dead-weight cargo as pig iron and steel rails from Alabama furnaces through Mobile will necessitate a deeper channel, certainly as deep a channel as ports that do not have to prepare for such heavy cargo and which now enjoy 30 feet or more of channel, such as Galveston, Texas City, Port Bolivar, Key West, Fernandina, Jacksonville, Brunswick, Savannah, etc.

Eighth. Because Mobile is the only port in Alabama, it is therefore the logical and nearest port for shipping the greatest tonnage produced by any State in the South, and must always be the accumulating point for the goods transferred over Alabama's large system of rivers, draining, when completed, a watershed of 44,120 square miles, or an area greater than that of New Hampshire, Massachusetts, Connecticut, Rhode Island, and Vermont combined.

Ninth. Because every possible element of risk, growing out of heavy loading of steamers so near the bottom, which is the custom at all competitive ports having insufficient depth of channel, should be eliminated to make Mobile a safe port in the opinion of insurance underwriters, shipmasters, and shipowners.

Tenth. Because Mobile can never reach her maximum growth until upon a parity with her competitors as to depth of channel, but must always operate at a disadvantage from any competitive territory, with New Orleans or Savannah, for example.

Eleventh. Because Mobile has demonstrated that she responds quickly to every increase in depth of channel, even though such increase still leaves Mobile handicapped as to depth, in comparison with her principal competitors.

Comparing 8 months, May to December 31, 1912, with 7½ months, May to December 15, 1913, during which latter 7½ months period deeper water was available at Mobile, we find an increase of over 61 per cent.

Foreign exports:

May to December 31, 1912	$18,348,421
May to December 15, 1913	29,623,261

Estimating foreign exports for period December 15 to December 31 at $3,000,000 (which is fair if Dec. 1 to 15 amounted to $4,063,760) would make the percentage of gain, with deeper channel, about 78 per cent.

Twelfth. Because Alabama has only the one port, Mobile, through which the tonnage of Alabama (including 1,125,000,000 tons iron ore, 57,600,000,000 tons coal, and 15,500,000,000 tons lignite in its area of 52,250 square miles) and the tonnage from that part of Mississippi (over 50 per cent of an area of 46,810 square miles) to which Mobile is the nearest port, or a total area larger than that of all New England States combined, should flow.

Thirteenth. Because the expenditures for harbor improvements for Alabama have not been as large as the expenditures for the several harbor improvements of the other Gulf and South Atlantic States, with the single exception of the State of Mississippi, to which latter State the port of Mobile is the nearest port for a large part of its territory.

Fourteenth. Because experience has proven the fact that harbor investments result in transportation economy and the statements, published in the Annual Report of the Chief of Engineers, part 1, 1911, page 79, as to increase in size of steamers and the effect larger steamers had upon rates at Boston—that 30 years ago steamers had a loaded draft 20 to 24 feet; 22 or 23 years ago of 25 to 26 feet; 14 years ago, 27 to 28 feet; 10 years ago, 28 feet 9 inches; later, 31 feet; and recently one of 33 feet 10½ inches; also "that freight rates, caused by larger class of steamers being used, are about 50 per cent less than they were 15 or 20 years ago, when very much smaller steamers were engaged in the trade" can safely be said to be the experience of the large ports the world over.

Fifteenth. Because the principal ports of the United States, of which Mobile is one, as shown by comparisons below, all handle their highly competitive foreign freights in the larger and more economically operated type of steamers as soon as adequate channel depth is provided, thus demonstrating that economy of ocean transportation is only obtainable by deep channels:

Position held by Mobile as to total value of exports and imports for year June 30, 1912, shown by Department of Commerce and Labor, as compared with over 70 ports of United States on Atlantic, Pacific, and Gulf coasts.

	Imports.	Exports.	Total.
1. New York	$975,744,320	$817,945,803	$1,793,690,123
2. New Orleans	75,089,887	149,160,910	224,250,797
3. Galveston	4,309,758	218,146,097	222,455,855
4. Boston	129,293,016	69,692,171	198,985,187
5. Philadelphia	85,038,185	69,069,730	154,107,915
6. Baltimore	26,438,400	92,210,877	118,649,277
7. Savannah	5,129,979	104,286,925	109,416,904
8. San Francisco	59,235,471	49,249,734	108,485,205
9. Puget Sound	39,011,250	63,745,572	102,756,822
10. Mobile	4,643,907	31,230,117	35,874,024

Position held by Mobile, as shown by Department of Commerce and Labor, as to number of vessels and their tonnage, entered and cleared in foreign trade year June 30, 1912.

Rank.	Entered.		Cleared.		Total.	
	Vessels.	Net tonnage.	Vessels.	Net tonnage.	Vessels.	Net tonnage.
1. New York	3,529	13,326,211	3,392	13,205,126	6,921	26,531,337
2. Puget Sound	2,918	2,244,309	3,041	2,550,357	5,959	4,794,666
3. Philadelphia	1,104	2,643,068	919	2,143,784	2,023	4,786,852
4. New Orleans	1,143	2,188,666	1,163	2,340,075	2,306	4,528,741
5. Boston	1,078	2,878,706	756	1,778,453	1,834	4,657,159
6. Baltimore	545	1,170,698	622	1,473,715	1,167	2,644,413
7. Galveston	383	1,024,549	507	1,348,404	890	2,372,953
8. San Francisco	324	847,634	415	1,115,756	739	1,963,390
9. Norfolk and Portsmouth	182	454,997	437	1,009,080	619	1,464,077
10. Mobile	567	667,255	599	724,741	1,166	1,391,996
11. Savannah	163	406,138	285	735,607	448	1,141,745

The above ports either have completed or are engaged on projects for channel depths of 35 feet or more, excepting three—Savannah, Galveston, with depths of 32½ feet at high water, and Mobile with only 27 feet.

Average net tonnage per vessel at the 11 principal export and import ports, as shown in their proper position as ports.

1. New York	3,833
2. Puget Sound	804
3. Philadelphia	2,366
4. New Orleans	1,963
5. Boston	2,539
6. Baltimore	2,266
7. Galveston	2,666
8. San Francisco	2,656
9. Norfolk and Portsmouth	2,365
10. Mobile	1,193
11. Savannah	2,548

The only port below the average as to net tonnage per vessel is Puget Sound, accounted for by fact that trade of this section is principally sail cargoes of lumber. The channel at Mobile of 27 feet—away below the channel depth of each of the other principal ports—compelling the use of the smaller and more expensive vessels, shows, by the average net tonnage per vessel, the disadvantage under which Mobile is operating in the foreign trade. The influence a channel has upon the average net tonnage per vessel in the same section can be noticed in case of New Orleans, as compared with Galveston—the available depth at Galveston being greater than available depth at New Orleans for same period under comparison.

Sixteenth. Because of the increase in size of both freight and passenger steamers under construction; because Mobile is to-day suffering from inability to accommodate even the larger freight steamers of Gulf trade; and by reason of the fact that a 30-foot channel could hardly be completed under 4 years from the present time (counting the delay in Congress after a favorable engineering report is made), it is imperative that channel plans to accommodate our traffic in 1918 be no longer delayed.

Yours, truly,

HORACE TURNER, *Chairman.*

Lieut. Col. CHAS. KELLER,
Corps of Engineers.

LETTER OF THE MOBILE LINERS (INC.)

MOBILE, ALA., *January 8, 1914.*

DEAR SIR: Referring to statement of December 13, regarding vessels handled by us at this port from May 1 to date, I beg to point out that these figures do not represent the draft vessels shown would usually draw, leaving this port, as they cover practically cotton season only. In the summer time vessels will be down to their dead weight draft shown in the right hand column. Furthermore, vessels have to be picked for this port in accordance with their draft. The harbor master will not authorize us to load to more than 25 feet without special permission, and even with special permission will not allow over 25 feet 6 inches; therefore, when it is time to decide on a vessel to come to Mobile, all the available vessels have to be gone over and the one with shallowest draft picked out and sent to Mobile. Even then vessels have to go elsewhere to complete, owing to not having sufficient water at Mobile. Take the example of *Nitonian*, the first vessel in the list furnished you. This vessel sailed for Charleston to complete with cotton; the *Asian*, the fifth boat shown in our list, went to Pensacola to complete, owing to insufficient draft at Mobile. The *Nitonian*, the eighth vessel shown on our list, had to go to Pensacola to complete. The steamship *Antilian*, the tenth vessel shown in our list, had to go to Pensacola, owing to insufficient depth of water at Mobile. Had we had as much water here as Pensacola has (30 feet) these vessels would have finished at Mobile and sailed direct, saving money for owners and enabling the owners to take lower rates of freight from Mobile in consequence. Therefore, you can readily see that picking vessels to suit the port, and booking cargo so that vessel will draw as little water as possible, has not entirely obviated the necessity of going to other ports to complete. Of course, these vessels that went to Pensacola to complete would take on any coal they needed at Pensacola instead of Mobile, as they would thereby gain the equivalent amount of tons for Mobile cargo that would have been taken had they taken coal at Mobile.

You will note the vessels which completed elsewhere did not load down to their full draft at Mobile. This was because it was impossible to start Pensacola to work to accumulate a part cargo for these vessels for any small quantities, therefore, it is necessary to give them, say, one-third of the vessel to work on, as otherwise restrictions would be too severe for shippers to furnish cargo under.

In addition to this it is a well-known fact that the larger the vessel the cheaper cargo can be carried on it. This is shown by the fact that on pix pinus charter a 750 standard (3,000-ton) vessel always costs from 7s. 6d. to 10s. per standard more than a 1,000 to 1,250 standard (4,000 to 5,000 ton) vessel, and a 1,600 to 1,800 standard (6,400 to 7,200 ton) vessel is about the same amount cheaper than a 1,000 to 1,200 standard boat. As an example, take the Leyland Line steamship *Nubian* (one of the largest vessels that has ever been to Mobile) and compare it with the Harrison Line *Wayfarer*, running out of New Orleans and Galveston.

	Net registered tonnage.	Capacity (bales of cotton).	Economical coal consumption.	Crew.	Days, Gulf to Liverpool.
			Tons.		
Nubian	4,066	15,000	36	49	18
Wayfarer	6,222	25,000	40	52	17

From this you will note that although the *Wayfarer* carries two-thirds as much cargo more than the *Nubian*, it only costs 4 tons more coal a day to run her, and only takes three men more to handle her, and she makes the voyage in the same time, or a day less than the smaller vessel. Naturally, the cost per bale is greatly reduced. Of course, a vessel the size of the *Wayfarer*, in order to retain her model and not take an excessive amount of propelling power, must be deeper draft. In this connection it is important to remember that Mobile is a fresh-water port, and 27 feet at Mobile is only equivalent to about 26 feet 6 inches at Pensacola, as vessels draw about 6 inches more in fresh water than in salt water.

Another thing to consider is that owners do not like to load their vessels down to the full depth of the channel. For instance, if the channel depth allowed is 30 feet, the owners do not feel comfortable unless they have over a foot of water under the bottom of their vessels, so that the vessels drawing 29 feet ought to have 30 feet in channel, as otherwise the vessel is inclined to suck bottom and to become unmanageable with the result that she goes ashore and there are heavy claims for account of the owners, insurance companies, and cargo.

If we take 25 feet 10 inches as a safe draft for a vessel to load to in fresh water at Mobile, on a 27-foot channel, 30.95 per cent of the vessels handled by us (42 vessels) would draw too much water if loaded to their full capacity for a 27-foot channel. In 1912 this percentage of vessels which were too big grew to 36.66 per cent, and in 1913 it was over 48 per cent of the vessels handled by us, which shows what a serious handicap lack of 30-foot channel is to the vessels already running here. As a matter of fact, it has been necessary to refuse to quote on Mobile's natural cargo, steel and iron products, and has also been necessary to coal vessels after leaving Mobile in order to carry as much cargo as possible. This is a very expensive proposition, taking into consideration the time lost and the extra charges at the second port.

Mobile needs 30 feet of water because of her proximity to Tampa. It is necessary, in carrying phosphate, to carry two bales of cotton to each ton of phosphate, in order to get the full benefit of both cargoes. This combination will put a vessel down to her dead-weight draft, which we have, more or less, shown above is over 27 feet. Vessels are continually growing in size; for instance, take the following figures of vessels handled by us:

	Boats.	Net registered tonnage.		Dead-weight capacity.	
		Total.	Average.	Total.	Average.
1910, 3 months	10	24,370	2,437	57,932	5,793.2
1911, 12 months	42	110,402	2,628.619	250,418	6,107.756
1912, 12 months	30	77,066	2,643.655	183,139	6,540.678
1913, 12 months	41	119,968	2,926.05	286,385	6,985

From the above you will note that not only the average net register tonnage and the average dead-weight capacity are increasing, but the volume of business is also increasing. If Mobile is to go ahead she should be in position to take full advantage of the opening of the canal. One of the first lines to take advantage of Mobile's physical location is the Atlantic-Gulf-Far East Line, which has already started a service from Mobile in anticipation of the opening of the canal. In this connection we beg to inclose letter from Messrs. Norton & Son, general agents of this line in America, which is of interest.

Yours, truly,

S. A. Le Blanc, *Manager.*

Lieut. Col. Charles Keller,
Corps of Engineers,

Mobile, Ala., *December 13, 1913.*

List of steamers handled by Mobile Liners (Inc.), from May 1 to date.

Name.	Sailing date.	Draft.				Deadweight draft salt water.	
		Forward.		Aft.			
	1913.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Nitonian	May 2	19	5	21	6	28	10
Agnello Ciampa	May 24	22	6	23	6	24	3
Mercian	June 6	24	0	25	0	26	3
Nordfarer	June 15	22	5	22	9	22	11½
Nyleakin	June 20	19	9	20	3	20	7½
Asian	June 25	21	6	21	7	26	6
Coningsby	June 24	21	4	22	0	21	2½
Montauk Point	July 16	21	7	23	0	25	8½
Nicosian	Aug. 3	20	7	22	1	28	10½
Kylemhor	Aug. 14	19	7	20	6	20	10½
Antillian	Sept. 1	18	5	21	2	26	6
Ninaan	Sept. 29	21	10	22	1	28	10½
Warrior	Oct. 16	17	6	20	10	24	3½
Meltonian	Nov. 2	21	0	22	8	26	3
Berwindmoor	Nov. 6	20	11	21	1	25	8
Albanian	Nov. 9	18	1	19	5	21	9
Kirnwood	Nov. 15	15	6	17	8	22	0
Alexandrian	Nov. 22	22	4	23	4	26	6
Ethyl	Nov. 26	15	0	16	0	20	5½
Springburn	Dec. 6	16	8	19	3	24	6

Note.—With exception of *Coningsby* above, all vessels' cargoes booked to suit draft available in channel or else took all cotton cargoes, which are only obtainable during the winter months.

Mobile Liners (Inc.).
By M. H. Hagar.

LETTER OF MESSRS. NORTON & SON.

New York, *January 3, 1914.*

Dear Sir: We acknowledge the receipt of your favor of December 31 in respect to the necessity of having sufficient depth of water at Mobile to enable steamers drawing up to 30 feet calling at your port. Some of our steamers loading regularly on the berth at New York for the Far East load up to a draft of 28 feet 3 inches, but, as you are aware, shipowners would require a depth of water at Mobile sufficient to leave a safe margin over the draft of the steamer when loaded before they would consider sending such steamers to Mobile to be loaded to their full capacity.

We intend to use Mobile extensively, if possible, in loading our steamers to be despatched from the Gulf, but it will be a serious handicap if we are prevented from using steamers that will enable us to transact the business under the most advantageous conditions; in fact, it might easily be that we would have to select a Gulf port other than Mobile. It is true we have steamers which load to a draft of 26 feet 8 inches and even less, but it is doubtful if we could afford to consider Mobile as a regular port for loading if we were compelled to restrict our business to certain sized steamers irrespective of the cost and even if we were willing to assume the greater cost of loading a small steamer as compared with the cost of loading a large steamer the business might not be practicable for small steamers.

As you are aware, the tendency is to increase the size of the steamers used in most of the trades in order to effect the saving accomplished when loading large steamers, and we should judge it would be on the part of wisdom to provide for the future as well as for the present time. We can not understand why there should be any hesitancy in deciding that 30 feet of water is far preferable to 27 feet; in fact, we do not believe that a depth of less than 30 feet should be considered if the growth of Mobile as a port is to be accomplished.

Yours, very truly,

NORTON & SON.

Mr. S. A. LE BLANC,
Mobile, Ala.

LETTER OF LLOYD'S AGENT.

MOBILE, ALA., *December 17, 1913.*

DEAR SIR: As Lloyd's agent at this port, as well as the representative of numerous foreign underwriters, I take the liberty of addressing you as to the importance of urging on the Government the necessity of increased depth in our ship channel. The increased commerce of this port is demanding larger and deeper draft vessels, and as these larger and deeper vessels offer inducements to our merchants in the way of freight rates, it is all important that our port be made of sufficient depth to enable our merchants to avail themselves of these advantages.

The present channel is narrow and not of sufficient depth to admit of safe and easy navigation to the late type of large and deep-draft vessels. It is a well known fact to pilots and navigating officers of steamers that when a loaded vessel is near the bottom she is difficult to handle, as the suction affects the steering of the ship, causing her to sheer and take the ground on the sides of the narrow channel—a number of these incidents have come under my observation and official action—entailing heavy losses upon the underwriters. From an underwriter's standpoint, I can not too strongly urge upon you the importance of recommending a depth of at least 30 feet for this port, in order to induce the underwriters to give us competitive insurance rates and to enable our merchants to avail of the lower freight rates given by larger and deeper vessels.

A very important factor connected with the depth of our channel is that during the winter and busy season we are visited by heavy northers, which cause the water in the channel to drop from 2 to 4 feet and vessels are frequently delayed several days waiting for high water. In order, therefore, to give this port the benefit of channel draft, the fall of water, caused by these northers, should be taken into consideration, and sufficient depth given to make the channel available at all times in all winds and tides.

I have been Lloyd's agent and ship agent in this port for over 25 years and my experience and observation is that the commerce has always been in excess of our facilities to handle it, and I hope that the Government will give us at least 30 feet to enable us to care for the present commerce and that which we may confidently expect in the future. I have the honor to be,

Your obedient servant,

MURRAY WHEELER,
Lloyd's Agent.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala.

EXHIBIT A.

LETTER OF THE MOBILE CHAMBER OF COMMERCE AND BUSINESS LEAGUE.

MOBILE, ALA., *May 8, 1913.*

DEAR SIR: Replying to your favor of April 10, I beg to advise you as follows:

I have asked Mr. Horace Turner, chairman of the foreign traffic committee, and Mr. Thos. W. Sims, chairman of the marine affairs committee, of the chamber of commerce, to secure for me the information requested in your letter, and from their reports to me I have compiled the following information, which I think is reliable:

1. *Schedule of port charges.*—Port charges are fixed by State statute, Code of Alabama, 1907, sections 4938 and 4950, which reads as follows:

"4938. *Rates of pilotage; vessels exempt.*—The master, owner, or consignee of any ship or vessel must pay the pilot who conducts a vessel into or out of the bay or harbor of Mobile at the following rates for actual draft of water at the time of pilotage: For every vessel crossing the outer bar of Mobile Bay drawing not more than 9 feet of water, $2.50 per foot; on every vessel drawing more than 9 and less than 11 feet of water, $3 a foot; on every vessel drawing not less than 11 and not exceeding 12 feet of water, $3.25 a foot; on every vessel drawing more than 12 and not exceeding 14 feet of water, $3.50 a foot; on every vessel drawing more than 14 feet and not exceeding 20 feet of water, $5 a foot; on all vessels drawing more than 20 feet of water, $6 per foot; and if any vessel proceeds to and from the city of Mobile via Spanish River, $1 per foot additional. But vessels trading between any domestic port on the Gulf of Mexico and the Port of Mobile drawing 7 feet or less of water shall not be required to employ a pilot, but if they do, their regular pilotage shall be paid. No fishing smack shall pay pilotage."

"4950. *Vessels exempt from pilotage.*—Any sail or steam vessel engaged in coastwise trade and plying between ports on the Atlantic coast or the coast of the Gulf of Mexico and the city of Mobile shall be exempt from the payment of any pilotage fees whatsoever, and shall not be required to have the services of a pilot in crossing the said outer bar of Mobile Bay and in navigating the waters of the said bay."

2. *Schedule of tug charges.*—I attach hereto a card,[1] marked "Exhibit A," which gives the scale of charges of the Mobile Towing & Wrecking Co. Towing is not compulsory by law. It may be convenient to use tugs at times in certain parts of the harbor.

3. *Schedule or tug charges for shifting of berths.*—These charges are as follows: (*a*) For steamers, $10 to $30, according to size; (*b*) sailing vessels, $5 to $10, according to size. Shifting is not compulsory.

4. *Schedule of harbor master's charges.*—These charges are as follows: (*a*) $5 for each shift of steam vessel under 1,000 tons net register; (*b*) $10 for each shift of steam vessel over 10,000[2] tons net register; (*c*) $5 for each shift of sailing vessel; (*d*) $10 for each shift of vessel to Spanish River.

These fees are allowed the deputy harbor masters. These charges are not nominally compulsory, but as a practical matter they are. Shipmasters in any harbor being more or less unfamiliar with the different wharves and their location require assistance. In nearly all harbors the tug captain furnishes this knowledge and actually takes charge and puts the vessel in her berth. At Mobile the harbor master has brought legal action against tug captains who attempted to assist the shipmaster and thus enforced these charges. The tugboat captains could easily and, in my opinion, should furnish all assistance necessary and relieve these vessels of these charges.[3]

5. *Ocean freight rates to North or Europe by ship and by minor consignment.*—Ocean rates vary daily, almost hourly, according to the quantity of goods to be moved and competition at the port. It is difficult to give such rate data as will form a basis of comparison at the different ports. Two important factors enter into the question of rates: First, the size of the vessel, and the dispatch given the vessel at the particular port. The size of the vessel coming into a port depends upon the depth of the channel. Necessarily the ports having the deepest channels and best facilities have the largest steamships and the cheaper rates. In the matter of dispatch Galveston ranks first among the Gulf ports, New Orleans second, and Mobile third. There is more tonnage out of New Orleans than out of Mobile, while Galveston and Mobile are on a parity as to tons of goods shipped, although Galveston has the advantage of a deeper channel, thus accommodating larger steamers.

6. *Wharf charges for handling and storing freight and for berthing vessels.*—The charges at Mobile vary somewhat at different terminals, but would average about one-half cent per 100 pounds, or 10 cents per ton for wharfage; three-fourths cent, or 15 cents a ton, for handling. Only two terminals at Mobile furnish storage. One of these terminals furnishes storage only in the open and the charges average one-half cent a hundred pounds, or 10 cents per ton, on lumber. The other terminal furnishes storage under cover and charges 25 cents per 1,000 feet, or about 12½ cents per ton; about one-half

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[1] Omitted.

[2] Mr. Pillans said this should be 1,000 tons.

[3] Stated by persons persent at hearing as not legally compulsory.

cent per 100 pounds, or 10 cents per ton, on other goods per month. It also leases by the month at 50 cents per lineal foot, 50 to 100 feet in depth, wharf space to those exporters wishing to accumulate their own goods in an independent manner. This method brings the storage to a little less than 10 cents per ton per month. The railroads having sheds (i. e., Mobile & Ohio and Southern) do not furnish storage but do accumulate their export goods under sheds for ocean lines using their terminals, obtaining their revenue therefor out of shipside rate, which covers the cost of delivery to and alongside vessels. The Louisville & Nashville and New Orleans, Mobile & Chicago have no covered sheds of their own and use other terminals at Mobile, to wit, the Mobile & Ohio and Southern and the city of Mobile, and those of the Turner-Hartwell Docks Co. There is no berthing charge against vessels in Mobile. The terminal revenue is obtained by charges against the goods themselves, as above stated. At New Orleans a charge is made against the vessel of 9 cents per gross registered ton and 1¼ cents sheddage, which is taken care of in the freight rate; but this charge, plus switching and unloading (say, $8 and up per car), amounts to more than at Mobile. At Galveston the charges are made against the goods, just as at Mobile, but the charges at Galveston are about double those at Mobile.

I inclose herewith, marked "Exhibit B"[1] and "Exhibit C,"[1] the tariffs of the Turner-Hartwell Docks Co. and the city of Mobile, which are the only tariffs covering wharfage charges which I have been able to obtain.

7. *Information as to additional charges that must be paid on export traffic, such as switching, etc.*—Mobile & Ohio and Southern, which handle about 75 per cent of the export traffic through ship side, have in their tariffs limited their ship side rates only to wharves reached by their own rails (i. e. the wharves of the Mobile & Ohio and the Southen Railway and wharves of the city of Mobile), and have thereby increased the rates to ship side upon all export goods arriving in Mobile over the Mobile & Ohio, Southern and destined to vessels berthing at wharves other than those reached by the rails of the Mobile & Ohio. This increase is of course exactly the amount of the terminal charges, which amounts to about from $4.50 to $8.50 per car, when car unloaded. This makes the rate to ship side on goods that come in over the Mobile & Ohio and Southern, passing over docks other than those mentioned, $4.50 to $8.50 when unloaded per car higher than they would be on traffic passing over docks above mentioned, and the same amount higher than the ship side rate at New Orleans and Galveston. This matter has formed the basis of a complaint by the Mobile Chamber of Commerce against these two railroads and resulted in a decision of the Interstate Commerce Commission to which I respectfully refer you. The case is styled Mobile Chamber of Commerce *v.* Mobile & Ohio Railroad and Southern Railway and is Interstate Commerce Commission Docket No. 4242. If you desire it, I can furnish you copy of this decision. I inclose you herewith a paper marked "Exhibit D,"[1] which gives the schdule of switching charges at Mobile.

8. *Information as to preferential lines of boats crowding out other lines.*—Until the decision of the Interstate Commerce Commission above mentioned, the Mobile & Ohio and Southern had exclusive contracts with certain lines of steamers operating out of the port of Mobile and refused to permit competing lines to use the wharves of the Mobile & Ohio and Southern and refused to issue through bills of lading in connection with such competing lines. This, of course, restricted the competition between ocean carriers. Since the decision above mentioned, the contracts between the Mobile & Ohio and Southern, on the one hand, and the steamship lines, on the other hand, have been changed to what is termed "preferential contracts," and such contracts are now in force between the above-mentioned railroads and the Mallory Line, the Munson Line to Cuba, Munson to South America, Mobile Liners (Inc.) to Europe, and the Seeberg Line for the West Indies and Windward Island service.

In order to show the effect of the exclusive contracts in force prior to the above-mentioned decision, I will state that the Horseley Line at one time operating from Mobile to European ports, had such an exclusive contract with the Mobile & Ohio and Southern. This contract was either canceled or expired, and a similar contract was entered into between the Mobile & Ohio and Southern and the Elder-Dempster Line, and when this contract was entered into between the railroads and the Elder-Dempster Line the Horseley Line stopped operating out of Mobile. Later, the contract between the Elder-Dempster Line and the railroads expired either by limitation or cancellation, and the railroads entered into a similar contract with the Mobile Liners (Inc.). Although the Mobile & Ohio and Southern refused to furnish wharf room to the Elder-Dempster Line and refused to issue through bills of lading to them, the Elder-Dempster Line remained in operation out of the port of Mobile. However, its service was greatly hampered.[1] The United States Shipping Co. at one time operated a service from Mobile to Colon, and the Mobile & Ohio later refused to cooperate with the United States Shipping Co. and refused to permit the vessels of that line to use the wharves of the Mobile & Ohio, and the United States Shipping Co. finally discontinued its Mobile to Colon Service. The United States Shipping Co. also started a line to Cuba and met with the same sort of opposition and finally abandoned its line to Cuba.

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[1] Omitted.

In ths connection I beg to say that I understand the Interstate Commerce Commission has required all rail carriers to file with the commission all contracts and agreements between the railroads and the various steamship lines, and the information regarding the nature of these contracts is therefore on file with the commission.

9. *Rates of insurance.*—The insurance rates are practically the same at the principal Gulf ports with the exception of insurance rate on cotton, which is one of the most important articles of commerce in the Gulf. Mobile pays a higher rate on cotton than New Orleans of about one-sixteenth of 1 per cent, or 5 cents per bale, on all cotton from interior points passing through the port. The principal cause of this increased rate of insurance is the disability of the Mobile ship channel, as it has existed up to this time.

I trust this information will be of service to you.

Respectfully,

WM. H. ARMBRECHT, *President.*

Lieut. Col. CHAS. KELLER,
Corps of Engineers.

STATEMENT OF THE JOINT RIVERS AND HARBOR COMMITTEE.

MOBILE, ALA., *July 21, 1916.*

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

As a general proposition, ideal loading for a steamship is a ton of 2,240 pounds to every 40 feet of cubical space in the ship. In other words, to give a ship her dead-weight capacity, and, at the same time, fill up her cubical space, requires cargo of a density of 40 cubic feet to the long ton.

Yellow pine lumber requires 65 cubic feet to the ton. Cotton, compressed to a density of 22 pounds to the cubic foot, takes up 130 cubic feet of space to the ton in a ship's hold. Pig iron, steel billets, ingots, and steel rails are of high density and a ton of these commodities can be loaded into 13 cubic feet of space in a ship's hold. To get the best results from both a revenue and an operating standpoint, it is most desirable to have a ship's cubical space entirely filled and, at the same time, have the ship loaded down to her marks with her full dead-weight carrying capacity.

The Government has spent millions of dollars in improving the Tombigbee River and tributaries which penetrate the mineral district of the State of Alabama. The purpose of this tremendous expenditure is to give cheap water transportation to the high density traffic from the Birmingham district to tidewater at Mobile. The failure of the Government to provide sufficient depth of water in the channel in Mobile Bay and over the outer bar to enable ships of the deepest draft to come and go will prevent dead-weight cargoes being economically and effectively handled by ships, and will defeat the purpose for which this money has been spent. To fail in this particular would be analogous to the construction of an expensive edifice and then failing to provide means of ingress and egress

Aside from the possibilities of cheap water transportation from the mineral district of Alabama to Mobile, permit us to present the present rail rate situation from that district to Mobile, as compared with the rail rate situation to other ports and from other mineral districts. For example, the export rail rate from Birmingham district to shipside Mobile (which includes wharfage), is $1 per ton of 2,240 pounds on pig iron, steel rails, blooms, ingots, and billets. The rate from the same points in Alabama to New Orleans is $1.40 per ton. The rate from Pittsburgh, Pa., to New York, on the same commodities, is $1.75 per ton. On account of the present shallowness of the channel at Mobile high density traffic is not attractive to ships loading at this port, for the reason that large ships can not load down to their marks and navigate the present channel (as per Mr. Le Blanc's reference to steamship *Nestorian*). To illustrate this point, say a vessel with 9,000 tons dead-weight capacity, when loaded, would draw 28 feet of water. If you fill her cubical space with cotton, lumber, and other light traffic, she would have 6,500 tons of cargo. A 6,500-ton cargo would put her down to, say, 26 feet 6 inches. Thus, you will see that she loses 2,500 tons of her dead-weight carrying capacity, or, in other works, over 27 per cent of her dead-weight capacity. If we had 30 feet of water, then she could lift 9,000 tons.

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[1] Mr. LeBlanc, of the Mobile Liners, stated that the Elder-Dempster Line now gets the same treatment at the Mobile & Ohio terminals as the Mobile Liners.

We would like to refer to the size of the vessels operating between Pacific coast ports and the Orient. Take, for example, the fleet of the Nippon Yusen Kaisha. The smallest of five boats advertised in the Official Railway Guide shows a burden capacity of 12,500 tons. The same general condition applies to nearly all of the fleets operated on the Pacific Ocean between this country and the Orient. This condition clearly demonstrates that large ships can be operated cheaper per ton, particularly on long runs, than small ships. Furthermore, on account of the very large ships being operated on the Pacific it will be useless and hopeless to expect the port of Mobile, or any other port with a maximum of 27 feet depth of water, to induce shipowners to serve us when ports with 30 feet depth are available. Many of the products used in the Orient, particularly cotton, naval stores, machinery, iron and iron articles, and tobacco, are produced tributary to the port of Mobile. The articles mentioned would make an ideal cargo for a heavy-draft ship. Without 30 feet of water in our channel the port of Mobile will be powerless to induce shipowners to give us liner service through the Isthmian Canal to the Orient. Birmingham, Ala., makes the cheapest pig iron in the United States, and, with the cheapest rail rates to tidewater and the possibility of even much cheaper rates by barges on the rivers, we think we are justified in asking for a channel sufficiently deep to give large vessels proper loading with high-density cargoes.

The advantages of the port of Mobile to supply cargoes to the Orient have been presented to shipowners, and they are impressed with our possibilities but have declined to consider this port on account of the shallowness of the channel. In cases where some but not all of the boats of a fleet could enter this port the owners would not consider using regularly any such port. A shipowner's contention is that it would work financial losses on him to use a port where it is necessary to pick and choose from his fleet to enable him to select a vessel that could load in the port. In other words, shipowners could not afford to make long-time contracts to move traffic to and from a port unless they could use any and all of the ships in their fleets to lift the cargoes and carry out their contracts.

It seems clear that the proper way in which to determine the necessity for additional depth in the channel in Mobile Bay is not so much by an examination of what has been done under conditions of insufficient depth of water necessary to accommodate vessels adapted to the dead-weight traffic of the territory served by Mobile, but rather contemplating the enormous volume of business from the great mineral district of Alabama, as well as other territory tributary to this port, which would begin to flow as soon as this obstruction is removed.

The territory in the eastern part of the State of Mississippi, for which Mobile is the natural and logical port, produces a very large quantity of cotton. For the past five years the said territory, beginning with Meridian, Miss., and extending to Jackson, Tenn., shipped through the ports of Mobile and New Orleans 434,848 bales of cotton originating at points on the Mobile & Ohio Railroad for export to foreign countries. Of that amount, 194,708 bales were shipped via the port of Mobile and 240,140 were shipped via the port of New Orleans.

On all this cotton the rates to Mobile are 5 cents per 100 pounds less than from the same points to New Orleans. Notwithstanding this differential in favor of Mobile, it will be seen from the figures just quoted that more than half of the cotton shipped from the territory indicated moves to New Orleans. This large proportion goes to New Orleans notwithstanding the difference in the rate and the further fact that the rail line originating same, for its own benefit, uses every legitimate means to secure the long haul to Mobile.

Memphis, Tenn., ships through Gulf ports for export to foreign countries from 350,000 to 500,000 bales of cotton annually. The distance from Memphis to Mobile, by rail, is 11 miles less than the distance from Memphis to New Orleans, by rail. The rail rates are the same. Notwithstanding these conditions, New Orleans handles 95 per cent of the export cotton from Memphis that moves through the Gulf.

We contend that the ability of New Orleans to handle larger ships, on account of deeper water, has a very material effect on the abnormal condition referred to herein. If the port of Mobile could accommodate vessels as large as can be accommodated at competing ports, this disadvantage would disappear and the present obstruction to this large and important traffic be removed. This argument is clearly demonstrated by the fact that during the year 1913 New Orleans handled 5,359,453 tons of foreign traffic, with 2,564 ships, showing an average of 2,090 tons per ship; Galveston handled 2,947,374 tons, with 1,376 ships, or an average of 2,141 tons per ship; Mobile handled 1,597,300 tons, with 1,386 ships, or an average of 1,153 tons per ship. From these figures you will see that our average tonnage per ship is about half of the average tonnage per ship handled at the other two ports mentioned. As a matter of fact, more ships were used in the port of Mobile to handle 1,597,300 tons than were required at Galveston to handle 2,947,374 tons, and that, too, in face of the fact that Galveston is strictly a low density port, the large majority of the traffic from Galveston being cotton.

Gentlemen, we contend that these figures show, conclusively, that Mobile is in greater need of deep water than either Galveston, New Orleans, or any other port handling a majority of low density cargoes.

Black strap molasses imported from Cuba through the port of Mobile.

	Tons.
Jan. 3, 1914, to June 30, 1914	21,966
July 1, 1914, to June 30, 1915	90,884
July 1, 1915, to June 30, 1916	74,520
Total	187,370

The Department of Commerce of the United States, Miscellaneous Series No. 33, contains the attached statement showing port charges at six of the leading ports of the United States, and gives credit to Ford, Bacon & Davis, engineers for the board of commissioners, port of New Orleans, for the data contained in the statement. The attached is a reproduction of the Ford, Bacon & Davis statement except as pertains to Mobile, which figures are not correct. The Mobile figures shown in statement attached were compiled by J. S. Taylor, foreign freight agent of the Mobile & Ohio Railroad and Southern Railway and are correct. As Ford, Bacon & Davis were engineers for the port of New Orleans, we presume the figures covering the port charges at that port are correct.

Cost of handling a hypothetical cargo at various ports.

	New Orleans.	Mobile.	Galveston.	Philadelphia.	New York.	San Francisco.
Pilotage:						
Bar inward	$80.00					
River or channel inward	35.00	$100.00	$80.00	$100.00	$82.60	$158.37
Shifting from one berth to another within harbor	30.00		[2] 10.00		[2] 5.00	
River or channel outward	42.00					
Bar outward	96.00	144.00	96.00	120.00	85.44	170.37
Total	283.00	244.00	186.00	220.00	173.04	328.74
Towage:						
Assisting vessels to dock inward		30.00	25.00	30.00	20.00	25.00
Shifting from one berth to another within harbor	[1] 90.00		[2] 50.00	[2] 45.00	[2] 40.00	[2] 50.00
Assisting vessel from dock to river channel outward	15.00	30.00	25.00	30.00	20.00	25.00
Total	105.00	60.00	100.00	105.00	80.00	100.00

[1] Indicates three shifts.

[2] Indicates one shift.

Cost of handling a hypothetical cargo at various ports—Continued.

	New Orleans.	Mobile.	Galveston.	Philadelphia.	New York.	San Francisco.
Local port charges:						
Harbor fee	$15.00					
Dockage of vessel	463.86			$229.53	(1)	$257.35
Wharfage or shed charges to vessel	77.31		$175.00		$1,050.00	
Total	556.17		175.00	229.53	1,050.00	257.35
Wharfage, or tolls on cargo:						
Inward cargo			994.00			198.80
Outward cargo			1,378.50			396.57
Total			2,372.50			595.37
Labor (stevedore):						
Discharging cargo	1,479.70	$1,188.00	1,573.48	1,199.35	1,340.00	1,597.50
Loading cargo	[2,3] 2,169.00	[3] 2,224.44	[3] 2,058.64	1,935.31	1,675.00	2,596.15
Total	3,648.70	3,412.44	3,632.12	3,134.66	3,015.00	4,193.65
Miscellaneous charges:						
Cotton inspection	11.52	11.52	5.76			
Local health or quarantine fee			10.00	10.00	10.00	.20
Running lines for vessels		4.00	8.00	6.00	6.00	
Other miscellaneous charges			7.68			
Total	11.52	15.52	31.44	16.00	16.00	.20
RECAPITULATION.						
Pilotage	283.00	244.00	186.00	220.00	173.04	328.74
Towage	105.00	60.00	100.00	105.00	80.00	100.00
Local port charges	556.17		175.00	229.53	1,050.00	257.35
Tolls on cargo			2,372.50			595.37
Labor	3,648.70	3,412.44	3,632.12	3,134.66	3,015.00	4,193.65
Miscellaneous charges	11.52	15.52	31.44	16.00	16.00	.20
Total expense, ship and cargo	4,604.39	3,731.96	6,497.06	3,705.19	4,334.04	5,475.31

[1] On account of physical limitations of purely public facilities, the ship is here assumed to spend entire 14 days at private wharves.

[2] Includes $168.80 overtime and night work.

[3] Because of the condition that Mobile ships only sacked wheat, the Moblie item includes $525 for loading 1,500 tons at 35 cents per ton; New Orleans and Galveston figures, based on bulk wheat from elevators include $70 and $89.60, respectively, for trimming only.

LETTER OF THE JOINT RIVERS AND HARBOR COMMITTEE.

MOBILE, ALA., *July 20, 1916.*

GENTLEMEN: In answer to your communication, dated June 7, advising that your board is not convinced of advisability of additional improvements at Mobile beyond increase in width of bay channel to 300 feet, at estimated cost of $515,000, for reasons below: (*a*) The recent increase in project depth from 23 feet to 27 feet has not been completed a sufficient length of time to determine fully its sufficiency or the need of still greater depth; (*b*) the commerce is quite stable in character and has not increased materially in the past 13 years, although the navigable depth has been increased considerably during that period; (*c*) the principal commodity of export is lumber, which can be handled in large cargoes and quite economically on a draft of 27 feet; (*d*) it does not appear that the benefits to be expected from a greater depth would be sufficient to justify the cost of the improvement at this time; we would reply as follows:

(*a*) The fact that the present or 27-foot channel, completed in July, 1914, is unable to accommodate the largest and most economical steamers that operate out of the Gulf, and which would come to Mobile with a 30-foot channel, unquestionably demonstrates that 27 feet is not sufficient depth for Mobile; and the further fact that the Federal Government has given 30 feet to ports upon the Gulf and South Atlantic whose tonnage is one-half that of Mobile, viz, Pensacola, Brunswick, Charleston; and in some cases only one-quarter that of Mobile, viz, Texas City, Port Bolivar, Key West, conclusively shows that, as to tonnage, Mobile is entitled to 30 feet. If 30 feet is necessary at ports handling much less tonnage, and particularly much less dead-weight tonnage, then 30 feet is also necessary at Mobile.

(*b*) Although Mobile has been handicapped for 13 years by having less depth of channel than competing ports upon both sides, there has been a decided increase in both tonnage and valuation during the 13 years referred to by your board.

	Depth of channel.	Tons.	Value.
	Feet.		
1901	21–22	1,616,440	$28,482,331
1913	26	2,212,805	61,368,688
1902	20½	1,746,219	29,565,526
1914	26–27	2,392,442	58,085,903

Thus you will note 1913 shows an increase of 596,365 tons, valued at $32,886,357, over 1901, an increase in valuation of more than 100 per cent, due to the deeper channel.

With still deeper channel in 1914, and in spite of the war for one-half of 1914, this year shows an increase of 646,223 tons, valued at $28,520,377, over year 1902, or an increase in valuation of almost 100 per cent. And the war deprived Mobile of a large part of its foreign commerce, this tonnage to five ports alone (Hamburg, Rotterdam, Antwerp, Bremen, Amsterdam) during normal years amounting to more than $10,000,000. Taking this tonnage into consideration the increase of 1914 over 1902 would run far above 100 per cent.

(*c*) While lumber is the principal commodity of the port, due to the fact that lumber is now largely shipped with cotton, naval stores, hardwoods, steel, etc., upon the European and South American liners of the largest size and deepest draft, only the deepest channels of the largest ports upon the Gulf can accommodate the large steamers loading the mixed cargoes of lumber and other goods.

We attach a memorandum of the larger steamers out of New Orleans during 1913, a normal year, which gives an idea of the loaded draft of large Gulf freight steamers carrying combination cargoes of lumber, cotton, naval stores, hardwoods, steel, etc.

The larger steamers of the Leyland Line, those over 5,000 tons, can not load mixed cargoes at Mobile. Already one of the smaller steamers of this line, loaded at Mobile, has shown rivets sheared off the bottom plates, undoubtedly done by dragging through our channel. What applies to Leyland Line applies equally as well to larger steamers of Munson Line used in South American trade; steamers of W. R. Grace & Co., used in handling nitrate of soda from Chili, and the other large liners unable to come to Mobile. Many of the steamers already deeply loaded at Mobile have not been considered safely loaded by owners, who object to their ships being loaded so near the bottom. Particularly is there objection now, at a time when even a moderate-size steamer is worth $2,000 or more per day, when the loss of a propeller or damage from sticking in the channel may cause long delays in discharging, repairing, and reloading. The loss to owners or underwriters in one such accident would amount to enough to pay the interest for many years upon the additional cost necessary to dredge 30 feet at Mobile.

(*d*) The benefits to be derived from a deeper channel at Mobile in the saving to shippers from lower ocean rates obtained from largest Gulf steamers, in the economy of fuel to steamers loading at deeper Gulf ports and unable to take bunker coal at Mobile, and in the elimination of the waste of 25 to 30 cents per ton necessary to forward beyond Mobile to deeper ports the coal, iron, steel, etc., that could and would be loaded aboard steamers at Mobile, are so great, as compared with the interest at 3 per cent upon $500,000 necessary to provide 30 feet, or $15,000 annually, as to unquestionably warrant the investment by the Federal Government in such 30-foot channel.

In reply to your invitation to submit statements and arguments as to the necessity of the improvements recommended by the district office—of a channel across the bar 33 feet deep and 450 feet wide, at an estimated cost of $62,200, and $15,000 annually for maintenance, and a channel 30 feet deep and 300 feet wide in the bay, at an estimated cost of $1,030,000, and $150,000 annually for maintenance—we beg to submit the following facts as to necessity of the deeper as well as the wider channel recommended by the district officer:

(1) Because the largest Gulf steamers, those most economically operated, and which furnish the cheapest ocean transportation, can not come to Mobile

until 30 feet of depth is provided, such, for example, as the larger steamers of the Leyland Line, larger steamers of Munson Line used in South American trade, large steamers of W. R. Grace & Co. used in nitrate of soda trade, and steamers of United States Steel Corporation and the Pacific coast fleet.

(2) Because ports of the size of Mobile, which ranks tenth in the total value of exports and imports in the United States, and eleventh in net registered tonnage of vessels entered and cleared in foreign trade—which foreign trade requires the largest steamers—should certainly be as well equipped as to channel depth as those ports upon Gulf and South Atlantic which handle a less volume of tonnage, such, for example, as Texas City, Port Bolivar, Pensacola, Key West, Fernandina, Brunswick, Charleston, etc.

(3) Because Mobile can not fairly compete with New Orleans and Galveston on one side and Pensacola, Savannah, Brunswick, etc. (all having 30 feet or more) upon the other side until Mobile has 30 feet at least.

(4) Because Mobile has an uncertain tide, a tide greatly effected by the north winds of winter, which shallow the water from 3 to 4 feet, this being the difference between the high-water expectancy at which ships deeply laden leave port and the water actually left by the northers of several days' duration. Also, because of fresh water at Mobile, there is a loss of 6 inches in draft as compared with ports having salt water. A steamer drawing 27 feet loaded at Mobile, in fresh water, will draw 26 feet 6 inches at Pensacola, in salt water, with the exact same cargo.

(5) Because the completion of the locks and dams of Alabama's river system will influence the movement to Mobile of vast amounts of coal, iron, steel, cotton, hardwoods, staves, etc., from that territory, richer in natural resources than any section of the South, one city alone, Birmingham, producing more tons of freight yearly than the entire State of Georgia.

(6) Because Mobile—the only port in Alabama and the logical port for concentration of the large tonnage of Alabama, including 1,125,000,000 tons of iron ore and 57,600,000,000 tons of coal in its area of 52,250 square miles, and also the nearest port for the tonnage produced in one-half of Mississippi with its area of 46,810 square miles, a combined territory greater than that of all the New England States combined—should receive the lowest ocean rates obtainable from the largest steamers operated in the Gulf and requiring channel depth of 30 feet or more.

(7) Because the millions of dollars spent by the Federal Government in creating year-round navigation to the coal and iron fields of Alabama, and in opening up 1,500 miles of navigable streams, would be largely nullified if there was a lack of deep water at Mobile, the natural port for breaking bulk.

(8) Because less than 30 feet at Mobile means the necessity of barging large quantities of coal, iron, steel, etc., at an expense of at least 25 to 30 cents per ton to ports beyond Mobile, where the larger steamers of the Gulf must go to load. To avoid the necessity of forwarding annually beyond Mobile just 60,000 tons of coal would pay the interest upon the additional half million dollars necessary to provide 30 feet at Mobile. And the tonnage from the Warrior River system already approximates 300,000 tons yearly, with a certainty of a vast increase in this tonnage by reason of the thousands of dollars now being invested by coal companies in floating equipment for this river service.

(9) Because steamers of the larger class, between 5,000 and 12,000 tons, after loading at New Orleans and Galveston, and which mainly coal at Pensacola and Norfolk, can not possibly come to Mobile for bunker coal until 30 feet or more of depth is provided.

(10) Because Mobile, being the nearest port to the iron and steel supply of Alabama, requires a deeper channel for this very deadweight cargo than ports upon the Gulf and South Atlantic with their lighter cargoes of cotton and lumber.

(11) Because Mobile, left with a 27-foot channel, must continue to select steamers to be operated in trade to Europe, South America, Cuba, and Pacific coast, to guard against steamers being loaded too near the bottom, there being numerous complaints from owners of ships that Mobile is not a safe port for some of the steamers already loaded at Mobile.

(12) Because Mobile, with a tonnage already sufficient to warrant a 30-foot channel, can not possibly expect, even with immediate approval of the board, to have a completed 30-foot channel under four years from the present time, counting delays in Congress and time necessary for dredging, and surely no port of the size of Mobile should be without 30 feet by 1920.

(13) Because Mobile, with more ship repairing facilities, both steel and wood, than all the Gulf ports combined, possessing more skilled machinists than any port upon the Gulf, and having the cheapest coal of any American port can not be made available as a repairing or coaling port for the United States Navy until 1920, even with the adoption immediately of the 30-foot project. And these facilities should certainly be made available at the earliest possible moment. Twenty-seven feet of depth, with requirements of Navy of several feet under keels, would prevent the accommodation of any of the larger war ships at Mobile. It would seem that the $15,000 per year spent by the Federal Government in interest charges to create a 30-foot channel would be well spent if for no other purpose than to open the facilities and coal at Mobile to the United States fleet.

In the last analysis, the question to be determined is: Shall the Federal Government incur an annual interest charge of $15,000—

To provide 30 feet at a port ranking tenth in size in exports and imports and eleventh in net registered tonnage of vessels entered and cleared in foreign trade, thereby attracting a larger amount of much needed steamer tonnage to Mobile.

To place mobile upon a parity with smaller ports which handle only one-quarter to one-half the tonnage of Mobile.

To enable more than 2,000,000 tons of freight valued at more than $60,000,000 to obtain the lowest ocean rates possible by making Mobile a safe port for the largest steamers operating in the Gulf.

To guarantee that through the millions of dollars spent by the Federal Government in locks and dams, the coal, iron, and other resources of Alabama shall enjoy the largest market and widest distribution upon reaching tidewater at Mobile.

To make available to the United States Navy, in case of need, both the cheapest coal in America and the largest ship-repairing plants upon the Gulf.

To permit the saving of 25 to 30 cents per ton upon all the coal and iron, steel, and steel products necessarily shipped by rail and by barge beyond Mobile to be loaded aboard the larger steamers at New Orleans and other ports.

And Mobile earnestly presents to you her case as that of being the neck of a bottle, the bottle including not only Alabama, parts of Mississippi and Tennessee, but also that large territory of the Middle West represented by St. Louis, Chicago, Kansas City, and Omaha, with the only impediment to the natural flow of this large commerce through the bottle to West Indies, Windward Islands, Central and South America, Europe and other countries as the insufficient depth of channel to accommodate the larger steamers that would seek Mobile, and urges upon your board the necessity of granting Mobile the much-needed 30 feet of depth. In other words, Mobile asks you to spend the additional 5 per cent necessary to insure the greatest benefits from the 95 per cent already spent in Alabama's waterways.

Respectfully,

HORACE TURNER, *Chairman.*

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

Steamers loaded at New Orleans during 1913, showing draft loaded outward.

	Draft.			Draft.	
	Ft.	In.		Ft.	In
Joan D'Arc	28		Saxonia	27	7
Prometheus	27	9	Californian	27	3
Custodian	28		Excelsior	27	8
Victorian	30	6	Phoebus	30	
Indian	30	6	Messian	27	6
Monarch	29		Maartensdijk	29	
Cestrian	29		Rathlin Head	28	8
Commanchee	27	9	Armenian	30	6
Bulyssis	27	8	Meltonian	27	8
Wayfarer	28	3	Gorredijk	29	2
Nubian	29	9	Colonian	28	3
Andijk	28	11	Atlantian	29	8
Oxonian	28	4	Kansan	29	5
Hesperus	28		Richmond	30	3

Some of above steamers were loaded as many as four times during 1913 at New Orleans, many were loaded two or three times, so we show the deepest draft of the several trips.

Exports and imports for year 1913.

	Exports.	Imports.	Total.
1. New York	$917,935,988	$1,048,320,629	$1,966,256,617
2. Galveston	281,457,858	7,820,638	289,278,496
3. New Orleans	169,980,277	82,399,100	252,379,377
4. Boston	69,552,657	146,599,451	216,152,108
5. Philadelphia	76,315,344	93,209,678	169,525,022
6. Baltimore	116,474,439	32,895,238	149,369,677
7. San Francisco	66,021,385	62,501,681	128,523,066
8. Puget Sound	62,548,100	51,473,683	114,021,792
9. Savannah	58,235,404	4,461,852	62,697,256
10. Mobile	27,823,998	3,675,180	31,499,178

Net registered tonnage of vessels entered and cleared in foreign trade, year ending June 30, 1913.

	Vessels.	Tonnage.
1. New York	8,089	28,834,780
2. Puget Sound	8,750	5,945,826
3. New Orleans	2,564	5,312,016
4. Philadelphia	2,173	5,158,600
5. Boston	2,623	4,969,419
6. Baltimore	1,488	3,493,832
7. Galveston	1,376	3,325,460
8. San Francisco	863	2,278,532
9. Norfolk	628	1,492,403
10. Sabine	678	1,422,587
11. Mobile	1,386	1,328,689

STATEMENT OF MANAGER MOBILE LINERS (INC.).

Mr. Turner has just covered the Mobile situation in a more or less general way and I would like to address you more specifically for a few moments on the subject from a steamship man's point of view. In order to take as little of your time as possible I have jotted down roughly a few statements from our point of view, because as I am not a speaker, I am inclined to ramble unless I have something to hold me down to facts. If you will, therefore, please excuse my reading this short statement to you, asking any questions on the subject you care to, I will be only too glad to advise you further about anything overlooked.

I am manager of the Mobile Liners (Inc.), a steamship agency representing at Mobile, the Leyland Line, Harrison Line, Maclay Line, Manchester Liners, Lamport & Holt Line, Hamburg-American Line. Deadweight capacity of vessels of these different owners that we represent amounts to several millions of tons deadweight cargo capacity. We have been in business in Mobile since October, 1910.

While most of the examples referred to by me are Leyland Line tonnage, it is because we have more Leyland Line vessels than any other of our lines, and what is true about the Leyland Line, is also true about the other lines we represent.

We have always been hampered at Mobile by lack of sufficient water in the channel and on the bar and when, after carefully picking out the smallest boats in their fleet, the owners which we represent have advised us which vessels they were going to send us at Mobile to load, we have always had to figure draft of vessels against bottom of the channel in booking any cargo, always seeing that we did not take more heavy cargo than vessels could carry on channel depth. This is especially the case with the four boats of the Leyland Line, whose names start with an "M," such as *Median*, *Meltonian*, *Memphian*, and *Mercian*, vessels drawing 26 feet 6 inches salt water when loaded to their deadweight capacity (27 feet at Mobile) and the 10 Leyland Line vessels whose names start with an "N," such as *Naperian*, *Nessian*, *Nestorian*, *Nicosian*, *Ninian*, *Nitonian*, *Nortonian*, *Norwegian*, *Novian*, and *Nubian*, which vessels draw 28 feet 10 inches salt water when loaded to their deadweight capacity (29 feet 4 inches at Mobile).

We have here a list of vessels we have loaded at Mobile in the past 12 months, as well as the average net register tonnage, average maximum draft and the average sailing draft from June, 1912, to date, from which you will note that the average sailing draft has followed increased depth in the channel very consistently.

	Average net registered tonnage.	Average dead-weight draft, salt water.		Average sailing draft, fresh water.	
		Ft.	*in.*	*Ft.*	*in.*
June, 1912, to June, 1913	2,850	24	0	20	8
June, 1913, to June, 1914	3,045	25	3	21	8
June, 1914, to June, 1915	2,813	24	7	22	3
June, 1915, to June, 1916	3,070	25	5	24	7

Out of the 14 vessels loaded in the past 12 months, 2 vessels have drawn 27 feet or over, 6 vessels have drawn 26 feet or over, 8 vessels have drawn 25 feet or over, and if you leave out of calculation the steamship *Kylemhor*, which made three trips and therefore counted for three-fourteenths of the average, the average for the last 12 months would be: Average net registered tonnage, 3,380; average dead-weight draft, 26 feet 7 inches; average sailing draft, 25 feet 9 inches.

In other words, leaving out the *Kylemhor*, only 3 of the vessels we loaded in the past year were loaded to a draft which was safe in present channel in the wintertime when the northers, as you know, lower the water here some 2 to 4 feet, and 8 of them would have had difficulty in getting down channel, as they drew over 25 feet.

When you take into consideration that it is only by picking over the fleets of all the owners we represent that we have been able to get vessels as small as the ones shown on the list attached, you must realize that we need deeper water at Mobile.

We also have here copy of extract of letter from Messrs. Frederick Leyland & Co. (Ltd.), dated June 24, 1914, copies of letters from the same owners dated June 16, 1914, and July 8, 1914, which I will read with your permission:

"We note *Norwegian's* draft of 26 feet 8 inches when sailing and we hope on arrival at Rotterdam captain will not have any trouble to report on account of the extreme depth. Frankly, we do not like these experiments being made with our steamers, and would prefer other steamers to obtain what satisfaction there is in knowing that they had the deepest draft of any steamers leaving the port."

Extract of letter from Messrs. Frederick Leyland & Co. (Ltd.), Liverpool, dated June 24, 1914:

"LIVERPOOL, ENGLAND, *June 16, 1914*.

"Messrs. MOBILE LINERS (Inc.),
"*Mobile.*

"DEAR SIRS: We are in receipt of your letter of the 31st ultimo, and are pleased to learn that you are taking up the question of draft of water with United States engineer. Thirty feet would certainly be an improvement on present conditions, for during the summer months we are unable to send our *Nubian* class to Mobile, as the cargo moving would put vessel at an unsafe draft, and especially so if vessel had part of cargo of phosphate. It is obvious that steamers carrying 9,000 dead-weight are more economical than vessels half the size, and it would therefore be much to our advantage if we could employ the larger vessels at all seasons, instead of as at present, when they are only able to load cotton and small quantity of lumber.

"Yours, truly,

"FREDERICK LEYLAND & Co. (Ltd.)."

"LIVERPOOL, ENGLAND, *July 8, 1914*.

"Messrs. MOBILE LINERS (INC.), *Mobile.*

"DEAR SIRS: We have received your favor of 27th ultimo, inclosing list of bookings you have on hand for Liverpool.

"*Rotterdam business.*—We note the arrangements made in regard to disposing of the bookings made for the *Nestorian*. In regard to Rotterdam, we have given Mr. Sanders the *Napierian* September 4 to take care of his grain bookings at that port, but we are a bit exercised as to the completion of the vessel. We appreciate that if she loads her grain at New Orleans first she may be too deep to leave Mobile, unless between the two ports some cotton and other light cargo is secured, which does not seem probable at the moment; then, again, if Mobile is made the first port, there is the danger of arriving late at New Orleans for the grain. However, Mr. Sanders has no doubt got these points before him and will have some suggestions to make.

"Yours, truly,

"FREDERICK LEYLAND & CO. (LTD.)."

The difficulty with *Napierian*, as above mentioned, is not an exception. We have the same steamship *Napierian* (which draws 28 feet 10 inches salt water, or 29 feet 4 inches at Mobile) available to load August 9. She is 4,000 tons phosphate at Tampa, and owners wish to complete her at Mobile. With present channel depth this is not possible unless we can fill her with cotton and nothing but cotton. With a 30-foot channel we could give her part cargo of lumber in addition to cotton. If we have to decide prospects are not good for full cargo of cotton, she will have to load elsewhere, which means a natural disadvantage and loss to our shippers, as well as detracting from desirability of Mobile in the eyes of the owners, as they will have to change tonnage around until they can find a vessel to lift their Mobile bookings, which, as they state in their letter of June 16, 1914, just quoted, is not easy this time of year.

As stated above, if there is any further information I can give you I will be very glad to answer any questions to the best of my ability.

What is true about these owners is also true with regard to the other lines we represent.

List of steamers loaded at Mobile by Mobile Liners (Inc.).

SEASON JUNE 30, 1912, TO JUNE 30, 1913.

Name.	Net tonnage.	Dead-weight draft.		Draft leaving Mobile.		Where bunkered
		Ft.	*in.*	*Ft.*	*in.*	
Almerian	1,910	22	5	22	4	
Student	2,304	24	8	23	0	Mobile.
Median	4,067	26	6	23	2	
Nubian	4,067	28	10	23	0	
Almerian	1,910	22	5	20	8	
Alexandrian	2,899	26	6	23	0	
Iriston	2,398	24	0	22	0	
Glendene	2,428	24	0	22	0	Do.
Melford Hall	3,506	26	6	20	0	
Kyleakin	1,976	21	0	18	2	
Median	4,067	26	6	17	9	Do.
Manchester Citizen	2,726	23	0	21	3	
Ethiope	2,475	24	0	19	7	
Nitonian	4,066	28	10	20	11	
Melford Hall	3,506	26	6	17	4	
Cuban	2,728	25	0	22	6	
Glensloy	2,342	23	0	17	11	
Nessian	4,012	28	10	17	6	
Wm. Cliff	2,169	22	6	22	2	Do.
Albanian	1,876	21	9	20	9	Do.
Memphian	4,066	26	6	22	6	Do.
Nubian	4,067	28	10	19	3	Do.
Kyleakin	1,976	21	0	19	6	
Meltonian	4,066	26	6	21	8	Do
Asian	3,680	26	6	23	0	Do
Kylembor	1,932	21	0	21	0	
Eberhard	3,709	23	0	23	0	
Kylestrome	2,106	22	0	21	0	
Nordamerika	1,685	22	0	21	4	
Nitonian	4,066	28	10	21	6	
Agnello Ciampa	2,381	24	9	23	6	
Mercian	4,066	26	6	25	0	Do.
Nordfarer	2,397	23	0	22	9	
Kyleakin	1,976	21	0	20	3	
Conningsby	2,158	23	0	22	0	
Asian	3,680	26	6	21	7	
Average	2,850	24	0	20	8	

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[1] Estimated.

SEASON JUNE 30, 1913, TO JUNE 30, 1914.

Name.	Net tonnage.	Dead-weight draft.		Draft leaving Mobile.		Where bunkered
		Ft.	in.	Ft.	in.	
Montauk Point	3,026	26	0	23	0	
Nicosian	4,097	28	10	22	1	
Kylemhor	1,932	21	0	20	6	
Antillian	3,678	26	6	21	2	Mobile.
Ninian	4,068	28	10	22	1	
Kyleakin	1,976	21	0	20	5	
Nitonian	4,066	28	10	23	0	
Warrior	2,265	25	0	20	10	Do.
Montauk Point	3,026	26	0	22	4	
Meltonian	4,066	26	6	22	8	Do.
Berwindmoor	2,702	25	6	21	1	
Albanian	1,876	21	9	19	5	Do.
Kirnwood	1,953	22	0	17	8	
Alexandrian	2,899	26	6	23	4	
Kylemhor	1,932	21	0	18	6	
Ethyl	1,952	[1]22	0	16	0	
Springburn	4,120	24	6	19	3	
Ninian	4,068	28	10	23	5	Do.
Arlington Court	2,833	[1]21	0	19	10	
Tunstall	2,438	22	0	11	3	
Nubian	4,067	28	10	22	5	Do.
Bechuana	2,659	25	6	22	6	
Kyleakin	1,976	21	0	19	3	
Kasembe	2,935	25	3	22	5	
Scythian	3,028	25	0	22	0	Do.
Montauk Point	3,026	26	0	22	0	
Fridland	2,737	24	6	19	3	
Nessian	4,012	28	10	25	3	Do.
Isle of Mull	2,772	25	0	17	0	
Kylemhor	1,932	21	0	18	5	
Asian	3,680	26	6	24	8	Do.
Napierian	4,101	28	10	20	6	Do.
City of Naples	3,714	26	3	25	3	
Dalton	2,263	23	6	25	9	
Orubian	2,412	25	6	24	2	Do.
Arcturus	1,525	20	2	20	2	
Kylestrome	2,105	22	0	20	11	
Novian	4,096	28	10	25	4	
Birmingham	2,612	24	3	24	3	
Scythian	3,028	25	0	20	5	Do.
Nessian	4,012	28	10	25	10	Do.
Albanian	1,876	21	9	22	5	Do.
Nitonian	4,066	28	10	20	2	Do.
Andromeda	1,546	22	0	18	7	
Nestorian	4,075	28	10	23	5	Do.
Nubian	4,067	28	10	25	11	
Strathnairn	2,812	23	0	20	8	
Kylemhor	1,932	21	0	18	11	
Ninian	4,068	28	10	25	7	
Nicosian	4,097	28	10	23	1	Do.
Napierian	4,101	28	10	24	11	Do.
Norwegian	4,056	28	10	26	7	
Montauk Point	3,026	26	0	24	5	
Average	3,045	25	3	21	8	

[1] Estimated.

SEASON JUNE 30, 1914, TO JUNE 30, 1915.

Name.	Net tonnage.	Dead-weight draft.		Draft leaving Mobile.		Where bunkered
		Ft.	in.	Ft.	in.	
Kylestrome	2,105	22	0	18	10	
Nestorian	4,075	28	10	26	6	
Albanian	1,876	21	9	22	1	Mobile.
Orubian	2,412	25	6	21	0	
Kylemhor	1,932	21	0	[1]13	6	
Kylestrome	2,105	22	0	19	4	
Kyleakin	1,976	21	0	20	2	
Alexandrian	2,899	26	6	23	0	Do.
Meltonian	4,066	26	6	22	0	Do.
Belgian	2,364	22	10	20	1	Do.
Kyleness	2,206	23	0	23	6	
Kylemhor	1,932	21	0	19	11	
St. Quentin	3,191	26	6	22	3	
Nestorian	4,075	28	10	23	5	Do.
Albanian	1,876	21	9	22	0	Do.
Kyleakin	1,976	21	0	21	2	
Alexandrian	2,899	26	6	26	4	Do.
Norwegian	4,056	28	10	25	1	Do.
Plutarch	3,587	27	0	23	8	
Nubian	4,067	28	10	27	4	Do.
Kyleakin	1,976	21	0	20	11	
Amsteldyk	4,231	28	6	27	5	
Average	2,813	24	7	22	3	

[1] Part cargo only.

SEASON JUNE 30, 1915, TO JUNE 30, 1916.

Name.	Net tonnage.	Dead-weight draft.		Draft leaving Mobile.		Where bunkered.
		Ft.	*in.*	*Ft.*	*in.*	
Nubian	4,067	28	10	27	11	Mobile, July.
Orubian	2,412	25	6	26	0	Mobile, August.
Kylemhor	1,932	21	0	20	0	Do.
Napierian	4,101	28	10	26	3	Mobile, September.
Kylemhor	1,932	21	0	20	11	Mobile, October.
Sylvanian	3,008	24	9	25	5	Mobile, November.
Alexandrian	2,899	26	6	24	9	Mobile, January.
Kylemhor	1,932	21	0	20	3	Do.
Sylvanian	3,009	24	9	23	1	Mobile, February.
Nicosian	4,097	28	10	26	6	Mobile, March.
Oranian	2,447	24	10	25	4	Mobile, May.
Nubian	4,067	28	10	26	10	Do.
Meltonian	4,066	26	6	27	0	Mobile, June.
Sylvanian	3,009	24	9	24	0	Do.
Average	3,070	25	5	24	7	
Excluding Kylemhor	3,380	26	7	25	9	

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

HEARING BEFORE THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS, IN REFERENCE TO MOBILE HARBOR AND BAR.

[Act of Mar. 4, 1913.]

JULY 25, 1916.

Col. Abbot, Col. Newcomer, Col. Winslow, Col. Taylor, Col. Shunk, Col. Flagler, and Col. Keller were present.

Senator John Hollis Bankhead, Senator Oscar W. Underwood, Hon. John W. Abercrombie, John T. Heflin, Hon. William B. Oliver, Hon. Edward B. Almon, Hon. George Huddleston, Mr. Horace Turner, Mr. J. S. Taylor, Mr. J. A. Parsons, Mr. S. A. Le Blanc, Mr. John T. Cochrane, Mr. T. E. Snyder, Mr. Stewart Brooks, and Mr. Oscar L. Gray appeared before the board in reference to the above subject.

Senator BANKHEAD. Mr. Chairman, I presume we may now proceed with the hearing and the investigation. I have no remark or statement to make to the board. There is a committee here from Mobile, composed of gentlemen who are thoroughly informed of the conditions there, and I am sure that they know exactly what they want.

I am going to present the chairman of that delegation, who will have charge of the hearing, who will present to you gentlemen who have come prepared to make a statement before this board. I will promise you in advance that the statements will be comparatively short.

I have, Mr. Chairman, the pleasure of introducing Mr. Horace Turner, of Mobile, who is chairman of this delegation, and who will take charge of the meeting.

STATEMENT OF MR. HORACE TURNER.

Mr. TURNER. Gentlemen, I thought possibly I could read more quickly than I could talk what I have to say, and make it a little more brief.

(Mr. Turner thereupon read a paper to the board, which is submitted to the board and made a part hereof.)

Gentlemen, I have attached to my paper a statement showing how we arrive at Mobile's position of tenth in exports and imports, also net registered tonnage, which is the class of steamers in the foreign trade which requires these vessels.

I will ask Mr. J. S. Taylor, who is the foreign freight agent of the Mobile & Ohio and Southern Railways, to tell you how this lack of a deeper channel affects directly the movement of export and import traffic through the port of Mobile.

Col. NEWCOMER. I would like to call your attention to one matter in connection with the commercial statistics that you gave. Your tonnage for 1914 apparently included all of the river tonnage as well as that of the seagoing?

Mr. TURNER. It did in the previous 13 years. I took that out of the annual report of the Board of Engineers, so the comparison is exactly the same in both cases.

Col. NEWCOMER. We do not have it in our tabulation here.

Mr. Turner. We got it from the annual report. We took the trouble to go to the assistant engineer and got the book and read from it in both cases.

Col. Newcomer. Both tonnages are given in the annual report, seagoing tonnage and river tonnage?

Mr. Turner. But is it not included in both averages?

Col. Newcomer. I do not think the 1902 report was put in the tabulation. We have made it, in 1902, 1,746,219, and in 1914 it is 1,768,457; in other words, almost exactly the same.

Mr. Turner. Have you compared the same periods? They have taken the tonnage and included in both years, apparently 1901 and 1902, and I think you will find that the tonnage is covered, and I think you will find these figures there exactly, for we took them out of the annual report at Mobile, from which I supposed they would naturally be the same.

Col. Newcomer. The only thing is to make certain that it included or excluded the river tonnage.

Mr. Turner. We have the relative difference here because we have taken it from the annual figures for 1902.

Col. Keller. In one case you did and in the other case you did not.

Col. Newcomer. I find, also, a list of steamers, schooners, and square rigged vessels that entered the harbor in 1914, and there were only 4 vessels that drew over 26 feet, 7 that drew from 25 to 26 feet, 10 from 24 to 25, and 12 from 23 to 24. Or, in other words, there were, altogether, only 33 boats out of a total of 897 that drew in excess of 23 feet in 1914.

Mr. Turner. Mr. Le Blanc has made up statistics in regard to that; and right there I would like to make this statement to you: We do not claim that we need 27 feet for all the steamers that come there, because a great deal of the business Mobile does is covered by the port of destination; in other words, if a vessel comes from Cuba she can only load so deep as that port will accommodate her loading. Therefore, in the sisal trade, for example, we need no more than 13 feet depth, because that is all you can get out of Progreso. That has a monopoly, and that is the only place you can get it. But it is the foreign trade that is destined to the deeper ports, such as Liverpool, Hamburg, Bremen, Rotterdam, and these deeper ships that come there, and there is the keenest competition of these large steamers, and it is the tendency to lower the rates to compete, and it has put us on an unfair basis as compared with the other ports, and it is for that trade alone that we need the deeper channel. Take the Pacific coast. We have steamers drawing 27 feet to 30 feet—boats of 10,000 tons. They would like to come through loaded with nitrate of soda, which is very heavy.

Take the boats, also, of the American-Hawaiian Line. I represented the line of Sudden & Christiansen, and the same was true of them. You will find right now, as Mr. Le Blanc will tell you, the boats of the Leland Line can take only a small percentage of the traffic. They do not want their boats scraping around close to the bottom. Their dead-weight draft is shown in this statement—for instance the *Victorian*, 30 feet 6 inches; the *Indian*, 30 feet 6 inches; the *Californian*, 27 feet 3 inches, etc. We have a complete list here that shows the class of boats that needs deep water.

Col. Newcomer. But the point I wish to make is that when you had 27 feet during that entire year you only had 33 vessels——

Mr. Turner. During 1914?

Col. Newcomer. During 1914.

Mr. Turner. We will grant you that we have not used the channel as we would have used it if conditions had been normal. We have cotton, lumber, steel tonnage, and traffic of that kind. We were cut out of 10,000,000 alone to four or five of those ports. They have been closed. There has not been any traffic there since the war came along in 1914, and it was in July, 1914, that we got 27 feet. We have been rubbing the channel mighty close——

Col. Newcomer. But the point I wished to bring out was simply that only a comparatively small percentage of the tonnage evidently can be carried in extreme draft boats; I mean those that use the extreme facilities. Most of the tonnage obviously is in boats which do not come up within a couple of feet of the draft that is available.

Mr. Turner. We will show that Mobile handles, next to New York, the largest tonnage from Cuba. You will find that we are absolutely unable to take care of this traffic, and develop this other business in the carrying of steel and cotton, etc., simply because we can not bring those boats in. They are all getting larger and bigger, and unless we get the water we can not bring them in.

Col. **Newcomer.** There is one other point that I think should be brought out in connection with your statement, and that is that we are comparing only the interest charge on the additional cost of the 30-foot channel without taking into account the additional cost of maintenance, which of course would be quite a sum.

Mr. **Turner.** I think the difference is only $25,000.

Col. **Taylor.** There is still another point. You compared Mobile with some of those ports that had 30 feet. As a matter of fact you mentioned a number of ports that did not have 30 feet. There are some ports on the Gulf that are still short of 30 feet. You gave Charleston as 30 feet. Charleston has 28 feet.

Mr. **Turner.** She has a 7-foot tide. She has this rising tide. She has got 33 feet, and we would certainly appreciate it if we could only work the tide and channel to that extent.

Col. **Taylor.** Savannah has only 26 feet.

Mr. **Turner.** But she has got the same tide.

Col. **Taylor.** But she is a long way up the river; they could not come on the tide altogether.

Brunswick has 30 feet at high water nominally, but practically it has not that much. That does not amount to very much anyhow. Tampa has 24 feet, and Tampa does quite some business.

Mr. **Turner.** Let me explain that business. Tampa has phosphate rock, mainly or almost exclusively phosphate rock. The boats that come there take that phosphate rock, and load so that they come out of there drawing only 20 feet, 18 feet, or possibly only 16 feet. If phosphate rock could be gotten at any other place you could turn the key on Tampa; nobody would go there for it. They have a monopoly. I likened that unto Progresso, where they have 13 feet of water. It is just like the boats that go there for sisal. They would not go there if Vera Cruz produced it. It is a very good, safe port. They go there because that is the only place you can get it, and no matter what it costs, you have got to bring it out.

Mr. Le Blanc sends his boats in there and takes three or four thousand tons of phosphate rock, because that is the ideal dead-weight cargo.

Col. **Newcomer.** They also have a large miscellaneous tonnage?

Mr. **Turner.** They have a lot of phosphate rock.

Col. **Newcomer.** They also have very considerable miscellaneous tonnage.

Mr. **Turner.** I am not arguing that they should not have it. I think any place that has 2,000,000 tons should be on that basis, because they can not properly compete without it, because the boats are getting larger. There is very little business to operate a boat that will take one-third or a half more cargo. It only makes a few tons and a little more in port charges, and a few more men; and the tendency is to get rid of the smaller boats and take on the larger boats. There is a competition between them. Of course they are going to get what the traffic will bear, but it is going to affect the basis of rates. We can not load this dead-weight cargo into them. We can not say, "This is our ideal cargo. We will take sisal or phosphate rock, or put in enough iron in order to load it fully and still get us out." The consequence is that you find that steel rails and steel billets and material of that kind is going through Mobile to New Orleans at 40 cents a ton additional rail charges.

But I think these matters should be stated by the other gentlemen, if you will permit them to do so. I thought I had better state our case——

Col. **Abbot.** There is one question that I would like to ask you. What would be the trans-Atlantic rate of a large steamer from Mobile as compared with the same steamer from New Orleans?

Mr. **Turner.** Well, at New Orleans it is rather difficult to answer that. I rather think Mr. Le Blanc can answer that better than I could. He is a steamship man. But here is what we find there at points like Memphis, where they have exacly the same conditions. They have about 95 per cent of the business and we get 5 per cent. They have bigger steamers. We have the same rates, but they get 95 per cent of the enormous cotton crop generated at Memphis. It applies through there, and you will find that all these big boats, like the *Monarch* and the rest of them, get the business.

Col. **Taylor.** That has something to do with the rates from Memphis to New Orleans?

Mr. **Turner.** It is exactly the same rate to both ports. There is not a bit of difference between the two. The mileage is the same and the rate is the same. I believe we are 5 miles closer to Memphis than to New Orleans.

Col. **Newcomer.** In other words, you have the Mississippi River as a competitor?

Mr. **Turner.** No; that rate has been made the same. There is the potential river competition to New Orleans, but the rate has been made the same——

Col. **Taylor.** Possibly the terminals at New Orleans may have something to do with it.

Mr. **Turner.** We handle it a little cheaper than they do, and we can handle it about as quick, when it comes down to this competitive business. I don't think it makes any difference to the shipper. He draws on Bremen for his money, he has his bill of lading, and he puts it in his bank, and he does not care what becomes of the cotton. It goes on what he calls through billing.

I will ask Mr. J. S. Taylor to say a few words.

STATEMENT OF MR. J. S. TAYLOR.

Mr. **Taylor.** Gentlemen, I, too, for the sake of brevity, will read my statement.

(Mr. Taylor thereupon read to the board a paper, which was submitted as a part of this record.)

In addition I have added a statement here with an explanation as to the origin of the information used by the United States Government in their miscellaneous series No. 33, except as to the port charge, in handling the same ship at the various ports. I have corrected the figures as to Mobile, because the original figures were incorrect. From that you will see that Mobile, in handling the same ship, is next to the cheapest port shown, with the exception of Philadelphia, which is a few dollars cheaper.

Mr. **Turner.** We will now ask Mr. Le Blanc to make a few remarks. Mr. Le Blanc represents the Mobile Liners (Inc.), an agency representing at Mobile the Leyland Line, the Harrison Line, Lamport & Holt Line, Hamburg-American Line, and others. He is therefore very familiar with all the problems of the steamship man, and he will be glad to answer any questions that the board may desire to ask him.

STATEMENT OF MR. S. A. LE BLANC.

(Mr. Le Blanc read a statement to the board, which was submitted as a part of this record.)

Mr. **Le Blanc.** You asked Mr. Turner about the difference in rates from New Orleans and from Mobile. It costs us 25 per cent more to operate from Mobile than from New Orleans, and this has given Mobile a black eye——

Col. **Abbot.** The question I wanted especially answered was, supposing Mobile had an increased depth so that she could take the same ships exactly that are going now to New Orleans. Would the freight on that ship from Mobile, say, to Liverpool be the same as the freight on the same ship would be from New Orleans?

Mr. **Le Blanc.** You mean the rate of freight or the earnings?

Col. **Abbot.** The rate of freight.

Mr. **Le Blanc.** The rate of freight would be the same.

Col. **Abbot.** Then, the difference in distance between Mobile and New Orleans is practically nothing?

Mr. **Le Blanc.** Practically nothing that way. We are competing at New Orleans all the time. There are no end of days when they come from Galveston and they need a deck load. They have no timber at Galveston and can not come into Mobile, and our timber shippers suffer. The boats want to get hold of that deck load and they will take it at a reduced rate. Timber is not like an interior commodity. It flows from the point where it originates, and our timber shippers are cut out from those deck loads.

Col. **Newcomer.** Is the rate on cotton from New Orleans to Liverpool at any particular time a certain figure, or does it depend upon the boat?

Mr. **Le Blanc.** It all depends on supply and demand, because we do not know when we book what boat it is going by. That is where we are hampered.

Col. **Newcomer.** Do you not book at a certain rate?

Mr. **Le Blanc.** We try to allocate the boats between the ports to the best advantage.

Col. **Newcomer.** So far as your shipper is concerned, his rate is fixed when he books?

Mr. **Le Blanc**. Yes, sir; it would not affect his shipments on interior stuff, but on timber it would be a different matter. We can not book a certain quantity of pig iron. We have to book it with modifications. We may book it ahead and get cotton to offset, or we may have 400,000 pounds of phosphate or 7,000 bales of cotton, and her deck load coming from Mobile, and it is going to cost somebody a great deal of money; or we may have to send her around to the owners at their expense to get that deck load. It means a loss to the Mobile timber shipper; he can not get the supplies. It is a very real difficulty, sir.

Col. **Newcomer**. The point I wished to bring out was that at any given time, then, according to statements, when the goods are booked you do not know the boat that it is going in?

Mr. **Le Blanc**. We do not know which boat.

Col. **Newcomer**. And the question whether you can use a relatively deep or light draft boat does not affect the rate of the shipper; it affects the profis to the carriers?

Mr. **Le Blanc**. That is on forward bookings. We know 35 days before the boat arrives which boat it is going to be.

Col. **Keller**. It ultimately affects the rate?

Mr. **Le Blanc**. Yes; because we have to play safe.

Col. **Abbot**. The rate that they charge depends upon the loading that you can get at all the different ports that your agency represents, and if you can get bigger ships at all the ports, or get uniform shipping, you can make lower booking rates than you could when you have to select cargoes of one thing or another?

Mr. **Le Blanc**. Yes, sir; and I do not suppose 25 per cent of the stuff that moves is booked ahead before the boat is known. But we are tied to that port for that 25 per cent of cargo. Suppose Mobile has got 2,500 bales of cotton to move. We have to give them a boat. What boat can we give them? We give them the smallest boat we can. Then we start in and book our 75 per cent. We say, "We can take some pig iron and take most of the cotton, because the combination will give more than either pig iron alone or cotton alone."

Col. **Newcomer**. Suppose your company were to send out a couple of boats at the same time to New Orleans, one of lighter draft than the other. As a matter of fact, is the rate usually different on commodities carried on those two boats?

Mr. **Le Blanc**. Mobile is always lighter——

Col. **Newcomer**. I am talking about New Orleans. You do not have boats sailing from New Orleans that do not require the total draft available?

Mr. **Le Blanc**. No; they do not require the full draft, but they require the full space that the vessel has available——

Col. **Newcomer**. You do have boats, lighter draft boats?

Mr. **Le Blanc**. Yes, sir.

Col. **Newcomer**. And if you should send them both out from New Orleans at the same time would the rates probably be the same on the two boats for the same commodities carried?

Mr. **Le Blanc**. Yes, sir; because the stuff sent in New Orleans goes upon book for those boats. They are booked two months ahead of time——

Col. **Abbot**. In other words, what the colonel means is that you charge a higher freight rate for a smaller steamer than you do by the larger steamer. That is your question?

Col. **Newcomer**. That is practically what it amounts to.

Mr. **Le Blanc**. To this extent, that if we can get the pig iron we can make a smaller rate on cotton. If our boat is too deep we can not take the pig iron. The boat has so many cubic feet of space and so many tons available for dead weight. We bid for tonnage against all the other ports. We run to Gavelston, Port Arthur, Texas City, New Orleans, Pensacola, and others, and if we can not get a combination of pig iron and cotton we can not afford to send the boats. We have got to send them where we can get the best earnings.

Col. **Keller**. What you mean is that if you find they can not make as much money operating out of Mobile they do not operate. The freight rate may be the same, but they do not send the boats there?

Mr. **Le Blanc**. Exactly. We have to bid for our boats just like at an auction. We have got to go where we can make the money. They say, "We are sorry, you have not got enough water and the other fellow has." Mr. Snyder can tell you that the boats are going where they can get the water.

Col. **Newcomer**. It is obvious, of course, that a harbor that has less water can not compete as favorably. But the point I am trying to bring out is that in a harbor of 30 feet depth like New Orleans where they have that amount available, whether the rates for the lighter draft and deeper draft boats are not actually the same so far as the shippers are concerned? In other words, that the savings goes into the hands of the shipowner rather than into the hands of the shipper?

Mr. **Le Blanc.** It goes into the hands of the shipper, inasmuch as a loss—it is a question that has come up at Mobile——

Col. **Newcomer.** I am not speaking about Mobile. What I am trying to get at, as a matter of fact, is that whether the rate is according to the draft of the boat, or whether it is the rate that prevails between the port of Liverpool, for example, and New Orleans, and it is paid by the shipper——

Mr. **Le Blanc.** There are certain shippers who have certain inland rates, 10 cents a hundred pounds cheaper than at New Orleans. If we can not give them a boat at Mobile they have to pay more than if the boat was loaded at Mobile.

Col. **Keller.** It deflects the traffic to a port of better service?

Mr. **Le Blanc.** It deflects the traffic to a port of better service, and at the expense of the shipper.

About phosphates: Two years ago we had those phosphate boats and loaded phosphate for Germany and they came there to Mobile and completed with cotton. We had 13 boats that came to Mobile. They took all the phosphate the boats would carry and completed loading with cotton. If Tampa needed 24 feet of water we would need more water, because I have never heard of a full cargo of phosphate moving. It would not pay; it would be just like taking a full cargo of pig iron—it does not pay. So for all the water Tampa needs, we need more.

Mr. **Turner.** Gentlemen, we want you to hear from one of our importers who handles the tonnage of blackstrap molasses used for feed and other purposes, which affects the import business. This tonnage in volume amounts to really more than our cotton tonnage. This man has been induced to come to Mobile and put up his plant there. He lives in Chicago. He selected Mobile out of all the other ports as the one most economical to operate from. He erected a great big tank to hold this molasses which comes in these big tank steamers, and is pumped into tanks and loaded out in train loads. The tendency to build big boats has affected him right now, and we asked him to come and discuss it with you, because it directly and immediately affects his line of business. I am going to ask Mr. Snyder, from Chicago, who is with us, to make a statement of just how it affects his business.

STATEMENT OF MR. T. E. SNYDER.

Mr. **Snyder.** Gentlemen, the nature of our business is the importing of blackstrap molasses, which is used for feed, in the manufacture of stock feed throughout the United States. The amount of it produced in the United States is too small to supply the requirements, and, therefore, it is necessary to go outside of the United States. At the present time we are getting it from the Hawaiian Islands, as well as from Cuba.

At the starting of this business, about two and a half years ago, the various ports were canvassed as to the ones that would be accessible and could handle it ordinarily. Mobile was chosen on account of freight rates that could be secured to interior points, making a saving to the users of this material and consumers of $1.20 per ton, figuring on a basis of 26 to 27 feet of water at Mobile.

During the past 60 days there have been new boats beginning to come out put into this service which draw 28 and 29 feet of water. There are two more boats under construction that will soon come out, being tank steamers which will be sister ships, all drawing 29 feet, which prohibits their going into Mobile; leaving one boat drawing 27 feet and one boat drawing 26 feet that we must depend on for our supplies, and leaving us without supplies a good portion of the time.

Our interests were found to be best served through the port of Mobile on account of the distribution and the service that could be rendered the users all through the central states. This material is used at Omaha, Kansas City, St. Joe, Minneapolis, Milwaukee, and Chicago, Louisville, and Cincinnati, and other points. The tank that we use at Mobile is the largest storage tank of its kind in the United States. It has a storage capacity of 2,200,000 gallons.

It is our wish that this place be continued, but unless an additional draft for those vessels can be obtained it will be necessary to send to other places where those boats can come in and make a distribution under a higher freight rate, which will cast a burden upon the user and the consumer—meaning the dairy people and all people who use horses throughout the United States, as well as the alfalfa producers, who will have to accept a less price, because the difference will have to be absorbed somewhere along the line——

Col. TAYLOR. Where do you use this material that you bring into New Orleans?

Mr. SNYDER. We are the handlers; we are not the manufacturers; we are the people that import it and distribute it.

Col. TAYLOR. Is it not used in the manufacture of something? You do not bring this material in in shape ready for use, do you?

Mr. SNYDER. Oh, no; it has to be manufactured. It is a mixture with alfalfa meal——

Col. TAYLOR. Where is it mixed? Where is it manufactured?

Mr. SNYDER. At all these points throughout the central states, beginning at the Missouri River and extending——

Col. TAYLOR. The factories are all distributed around?

Mr. SNYDER. Yes, sir. In fact, it is a growing business to this extent: Some five or six years ago there were three concerns in the United States making molasses stock feed. Last year we shipped molasses in tank cars to 142 different users. It is one of the businesses of the United States that is growing very rapidly now. It is found to be a scientifically balanced ration for all horses, mules, and dairy cattle. Also it is used in the manufacture of pig feed. The farmers are now using it to fatten their cattle on, in addition to giving them a certain amount of molasses stock food in addition to the grains that they have on their places.

There was an item in the St. Louis Stock Yard Journal a short time ago saying that one of the best shipments of cattle that had been received at those stockyards came in showing the test that had been made of molasses feed in addition to what the farmer raises himself, and showing how much he saved by giving a certain percentage of molasses feeds, and how much more he derived from his stock at the stockyards by using it.

Col. TAYLOR. What is the material it is mixed with?

Mr. SNYDER. Molasses is the basis for alfalfa meal and a certain percentage of cottonseed meal, crushed corn, and oats. Various manufacturers have certain formulas of their own. Some put in more of one item and some more of another, in order to bring it to a certain standard, according to the portion of the United States in which they distribute their product.

As to the location of these plants, I might say that we start in with Meridian, Miss., and Birmingham, Ala., St. Louis, Memphis, Nashville, Cincinnati, Columbus, Ohio, Cleveland, Chicago, Peoria, Milwaukee, Minneapolis, Omaha, Kansas City, St. Joe, and Clinton, Iowa. Then there are various other places in between those, but that fixes the radius at which it is served to those places.

Col. KELLER. Is the rate higher from New Orleans than it is from Mobile?

Mr. SNYDER. Yes, sir; there is a certain differential in there——

Col. WINSLOW. To all those places?

Mr. SNYDER. I think it is 2 cents.

Col. WINSLOW. I thought one of the gentlemen said it was the same rate from Memphis to New Orleans as from Mobile to New Orleans——

Mr. TURNER. That is on cotton.

Mr. SNYDER. This is on blackstrap molasses that carries a 3-cent differential above the blackstrap produced in the United States. This is import molasses and it is necessary to fill out the requirements in addition to that produced by all of the sugar factories in the United States, including those in California. It is all required and even more than has been imported. There is a demand for more than we have been able to produce.

Col. KELLER. How much of this blackstrap have you imported into the United States in the last four years.

Mr. SNYDER. It is really a new business. This was started in January, 1914. The first half of that year we imported 22,000 tons. During the fiscal year from July 1, 1914, to June 30, 1915, we imported 90,000 tons, and from July 1, 1915, to June 30, 1916, 75,000 tons. The difference in these figures was caused by the inability to get the supplies in connection with the boats that could come into Mobile Harbor.

Col. **Newcomer.** Would it make any difference to the general public in the interior of the country that consumes this material whether it comes in at Mobile or New Orleans?

Mr. **Snyder.** It would only make this difference: In the amount of service that is rendered from the time it can be consumed and the facilities for handling it. We can save from two to three days' time on each car that is shipped out. The boats require one day longer going to New Orleans and one day longer returning, and all of those charges would mean an increased cost, and the people would derive the benefit of a saving of about three days. The terminal facilities rendered at Mobile are sufficient and are situated so that we can load a trainload of molasses in about eight hours, and the railroads immediately start with it, whereas in New Orleans during the past week it has been necessary that we load certain cars over there, and it takes two days to get the car placed to the loading point and the same time to get it out on account of the terminal switching facilities. The larger the city the slower the switching arrangements are and the more time is consumed in handling cars around through the terminals.

Col. **Newcomer.** What are the ports that bring in this material?

Mr. **Snyder.** It is handled through Philadelphia, through New York, New Orleans, and Key West.

Mr. **Turner.** Gentlemen of the board, although we were trying to make our remarks short, I see that we have taken an hour and 20 minutes, when we intended to take only an hour. We are here, however, and would be glad to answer any other questions that any one of you gentlemen might care to ask.

I would like, if the board could find the time to do so, to have the board come to Birmingham and see the preparations being made by those coal and iron people who use that river and the prospective tonnage that is going to flow down that river. We have to have a deeper draft than any port on the Gulf. We have got to have at least 30 feet. I think it is even insufficient for the class of traffic that is going to be handled there, because it is that heavy traffic, heavy material; and if we do not have a proper depth at this point, we will be forced, either by rail or water, at a cost of 25 to 30 cents a ton, where the boat can take it, because, as Mr. Taylor told you, one company has made a contract for 100,000 tons that has to go through New Orleans at a cost of 40 cents a ton extra. They can not get out with the class of boats that we have available. The boats are getting larger instead of smaller and are drawing more water. So that if the board can do it, I think it would be impressed by the amount of money being used by the steel people and the coal people if they came down there at Birmingham, as I said. They are going into it heavily and investing their money preparing to handle this tonnage, which is all ready, as I think, approximately, the last time I noticed it, something like 300,000 tons through that Warrior River system.

Col. **Flagler.** The project provides for both increased width and depth. What would you rather have, the width or the depth?

Mr. **Turner.** The depth, every time. The wider it is the more boats are going to be brought in by propellers and the higher will be the maintenance charge; but we would rather navigate through a too narrow ditch than to have a wider one and not be able to handle the boats at all. Three hundred feet is certainly narrow enough for a 30-foot channel, but we would rather have the depth, because then we could get the boats in and out, and we can not do it now.

Col. **Taylor.** You spoke about the preparation that the steel companies were making. Have they actually got anything more than experimental plants there at the present time?

Mr. **Turner.** I was very much impressed with what Col. Crawford told me. It impressed him when he went up there and looked around. That is the reason I thought we would invite you to come down there. I think you would be impressed just as much as he was with the plants. They have put a good deal of money into this. They are building these barges, and many of these people have been experimenting around and I do not think that they have possibly decided in their own minds the most economical methods of operating. I think that will all have to be worked out. But those men are spending their money and putting it into the plants, and when a man spends his money he certainly means business.

Col. **Newcomer.** Has any steel been actually shipped by barge?

Mr. **Turner.** Yes, sir; there has been some pig iron come down the river, but I think—well, I do not want to mention somebody else's business, but I heard it discussed. I think the Steel Corporation, the Tennessee Coal & Iron people, had been discussing shipping their stuff from Mobile to Texas ports. The rates are very high over there—something like $5.50 to Galveston. I think they have been trying to study a combination that will cover that situation and carrying down there such of their material as is not breakable. They do not like the extra handling of anything like kegs of nails, for example, that are put up in frail packages. They do not want it handled more than the one time it is handled at Pittsburgh. But rails and bars can be brought down and transferred and loaded on barges that will draw 12 feet.

I would not be surprised if that was decided upon as the most economical method of working it out. They have already made a contract with the Alabama-New Orleans Transportation Co. and they have been using some of those barges—I suppose I am talking out of school and I would not want this to get into the public print. They got me to get up some data for them——

Col. **Keller.** Are they not building some sort of an electric road from Birmingham over to Locust Fork now?

Mr. **Turner.** The last time I saw it they were going to ask for bids for their right of way. I do not know exactly how far it has gone, but I am satisfied that if the board would go down there it would get a chance to see the plans they have. I have a great hesitancy in saying anything about it, because a lot of the things I have heard were in confidence, and I would hate to be quoted.

Col. **Newcomer.** I would like to ask Mr. Le Blanc another question. I was not satisfied with it before, and I think I can get at it this way: You spoke about shipments made from Mobile in different years, showing boats of different drafts, and you gave us the average dead-weight draft and the average draft at sailing. At any particular time were the boats of different drafts? In other words, did the rates on those different commodities on those different dates differ, or were they the rates on the same commodities?

Mr. **Le Blanc.** These boats out of Mobile?

Col. **Newcomer.** Yes, sir.

Mr. **Le Blanc.** For instance, we would be loading a small boat and a large boat. I think the idea was always to keep our rates above New Orleans, because they loaded bigger boats. We tried from the beginning to get 2 cents a hundred pounds higher than the rate our owners were taking from New Orleans. Our intention and endeavor all the time was to keep our rate a little above, because we were handling the little boats.

Col. **Newcomer.** A little above New Orleans. But the point was that your rates were the same for those two boats; you did not charge a different rate——

Col. **Keller.** But if they had all been large the rate would have been the New Orleans rate?

Col. **Newcomer.** That is entirely clear; I am not disputing that. What I want to know is whether the stuff is carried out on a smaller draft or a deeper draft boat it pays the same rate?

Mr. **Le Blanc.** Yes, sir.

Col. **Keller.** Would not that be true if the deeper draft boats largely predominated?

Mr. **Le Blanc.** Yes, sir.

Mr. **Turner.** Let me explain that rate situation if I can. After all, the rates are made by the most economical service obtainable, and the tramps set the rates. If a tramp is small and is operated at a higher cost, necessarily her rate of operation is higher. These rates have to follow. After all, the tramps will set the rates for the liners. Where you can operate one cheaper, there is no question but that the tramp will come into Mobile and lower the rates. The tramp steamers equalize the low rate of insurance. After all, they set the pace; and if you get deeper water, you would have deeper tramps come there. These ship agents would sell space on the boats for $500 wherever they can. Their margin would be $500. If a man can bring a boat in there and make his $500, he is going to get it. Suppose at New Orleans the rate was set by a deeper draft boat and you had a 25-foot boat in there and a 30-foot boat set the rate. The 25-foot boat can not get any more than is asked by the agent of the steamer drawing 30 feet. Generally the rate is set by a tramp. If it is setting the pace over there, the boat drawing 25 feet is going to make the same rate.

Col. **Newcomer.** The point made by Mr. Le Blanc was that he endeavored, in fixing his rate, to keep it at 2 cents higher than New Orleans.

Mr. **Le Blanc.** We do not always get it, Colonel.

Col. **Newcomer.** But you have got to do that on the same rates, whether you send it in a small or a large boat; and the point would be that the boat that goes out of Mobile having a capacity draft of 25 feet would probably go out with a higher rate paid by the shipper than would be the case with respect to New Orleans?

Mr. **Turner.** For a large part of the cargo, yes. They have got to take what they can get.

Col. **Newcomer.** You have tramp steamers, of course, of all sizes?

Mr. **Le Blanc.** Not so many at New Orleans. New Orleans is practically a liner port, like New York.

Col. **Newcomer.** How about the other Gulf harbors in that respect?

Mr. **Le Blanc.** I think Mobile has got about as many tramp charters in proportion to her size as probably almost any port except Savannah.

Col. **Newcomer.** Under given conditions of shipping, where you have several tramp steamers together of different sizes, are they not apt to get the same rate?

Mr. **Le Blanc.** Offsetting insurance, they get the same rate we do. They try to get as much as we are getting, and we try to take the traffic at as little as they are quoting.

I want to explain that it takes a year or two for the information to reach the nations abroad that Mobile has 27 feet of water. The effect of it will not be felt until the information has been spread abroad. They do not always believe what they hear about our ports; but after they get it you will find that they will have bigger boats. The boat will go to a dead-weight capacity with pine lumber, which is not a light-weight cargo. The owners have been sending in these smaller boats because it has been a shallow-draft port. A boat that will carry 750 tons will cost about 10 shillings more at normal times than a boat that will carry 1,000 to 1,200 tons and the boat that will carry 1,800 tons when it comes to timber. She is so big that people are afraid to handle her, and they say "If you will take that boat and charter it, you will have to give us an inducement that it is going to draw 27 to 29 feet, or else we can not come to terms."

We have not been able to have those boats because we did not have the water on the 23-foot channel. The information has not gotten abroad. The liners know it because they are operating. The tramp owner does not know it.

Col. **Abbot.** Is the number of independent craft increasing or decreasing?

Mr. **Le Blanc.** Decreasing, I think, sir. They had a line that ran to Glasgow, and their reason for operating on a regular service was that they could see the handwriting on the wall—the day when there would be no more tramps—and they wanted to start a line of their own. Another line operated a service from New Orleans to Glasgow, and now from Mobile to Glasgow and Belfast. Formerly they never considered a regular service.

Col. **Abbot.** Is the change taking place by reason of going into other service, or by reason of the fact that the tramp owners are utilizing their tramps on regular lines?

Mr. **Le Blanc.** They are looking around for a regular service in order to get into a regularly established business of their own. They do not want to be tramps. They are like the man on the corner who sells newspapers; he wants to settle down and have a little business of his own; and the tramps want to do the same thing. They want to become respectable and become a regular line.

Col. **Abbot.** Then, the rates are higher?

Mr. **Le Blanc.** There is always the little fellow who butts in in the water transportation. You can not close the traffic. We have got a very good example of that in the service to the resorts around Mobile. Time and again they tried to form a combination, but some little fellow with a launch will break the rate.

Col. **Newcomer.** That is true with the coastwise traffic generally?

Mr. **Le Blanc.** That is under peculiar circumstances. It is not open to competition.

Col. **Keller.** It is under the direction of the railroads?

Mr. **Le Blanc.** No. There have been times when they wanted to do that. They have to be American boats to run coastwise.

Mr. **Turner.** The tramp tonnage is just about as large as the liner tonnage now, and they practically set the rates. The liners do not like to acknowledge it, but there is no question that they are an awfully vital factor in the rate situation.

Mr. **Taylor.** Gentlemen, it may be of some benefit to you for me to state that the competition in ocean rates extends from Norfolk—that is, on cotton—to Galveston. The usual differential in the ocean rates from the Gulf is 7 cents higher than from Savannah. The Savannah rate would be affected by Norfolk, Brunswick, Charleston, and, therefore, there is the whole Atlantic coast that would affect the Gulf rates. Whenever the differential of the ocean rates broadens to greater than 7 cents a hundred pounds, then cotton that would naturally move to the Atlantic seaboard would come through the Gulf. The Galveston rate affects the New Orleans rate; so it is a competitive proposition from Galveston to Norfolk as far as the ocean rates are concerned.

Col. **Newcomer.** I think we were told that the Brunswick rate on cotton was 10 cents higher than the Galveston rate.

Mr. **Turner.** The other way around.

Mr. **Le Blanc.** At the present moment?

Col. **Newcomer.** That was a year ago.

Mr. **Le Blanc.** That was due to the liners, I think. As I said, Mobile had more tramps than any other port except Savannah. The tramps were higher than the liners. There have been very few tramps loading cotton this year, and if Mobile had had to depend on tramps they would have failed.

Col. **Abbot.** We are very much obliged for the information you have given us. You have kept your time down very well, considering the amount of information you had to present.

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House Doc. No. 1763 ; 64th Cong., 2d Sess.

4th Congress, } HOUSE OF REPRESENTATIVES. { Document
2d Session. } { No. 1775.

NEW RIVER, N. C., AND INLAND WATERWAYS BETWEEN BEAUFORT HARBOR AND NEW RIVER, AND NEW RIVER AND SWANSBORO.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON REEXAMINATION OF NEW RIVER, N. C., AND INLAND WATERWAYS BETWEEN BEAUFORT HARBOR AND NEW RIVER, AND NEW RIVER AND SWANSBORO.

December 19, 1916.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

War Department,
Washington, December 18, 1916.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated the 15th instant, together with copies of reports from Capt. C. S. Ridley, Corps of Engineers, dated (*a*) March 22, 1916, with map, (*b*) February 29, 1916, and (*c*) February 29, 1916, with map, relative to projects for improvement of New River, N. C., and Inland Waterways between Beaufort Harbor and New River, and New River and Swansboro, made by him in compliance with the provisions of the river and harbor act approved March 4, 1915.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, December 15, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Reexamination of New River, N. C., and inland waterways between Beaufort Harbor and New River, and New River and Swansboro.

1. Under authority contained in section 14 of the river and harbor act approved March 4, 1915, there are submitted herewith for trans-

mission to Congress reports dated (*a*) March 22, 1916, with map, (*b*) February 29, 1916, and (*c*) February 29 1916, with map, by Capt. C. S. Ridley, Corps of Engineers, relative to the projects for improvement of (*a*) New River, (*b*) waterway between New River and Swansboro, (*c*) waterway between Beaufort Harbor and New River, i. e., portion between Beaufort and Swansboro.

2. The existing project for improvement of New River, adopted by the river and harbor act of June 25, 1910, provides for dredging a channel 200 feet wide and 5 feet deep at mean low water from the mouth of the river to Jacksonville, a distance of 23 miles, at an estimated cost of $6,700. There was formerly an extensive traffic between this river and Wilmington by way of the inlet at its mouth, but this no longer exists, and all commerce that now passes out of the river goes through the unimproved and improved channels of the inland waterway route between the New River and Beaufort. Hence the district officer deems it advisable to abandon improvement designed to afford access to the river by way of the inlet and to provide a more convenient connection with the inland waterway route. He recommends a channel 4 feet deep at mean low water and 40 feet wide by way of Howards Bay and Salliers Bay, as shown on the accompanying map, at an estimated cost of $5,202 and $400 annually for maintenance. Aside from this modification he proposes no changes in the existing projects for improvement of the waterways between New River and Swansboro, and between Beaufort and New River. The division engineer is in general accord with the views of the district officer.

3. As the alternate channel proposed will serve a more useful purpose at less cost than the one provided for by the existing projects for New River and the waterway between New River and Swansboro, the Board of Engineers for Rivers and Harbors concurs in favoring its adoption, but it believes that a depth of 3 feet at mean low water, the same as the project depth on the eastern link of the inland waterway, will be sufficient, and it recommends the work proposed by the district officer with this change. As these three waterways are essentially parts of one through waterway between Beaufort and Jacksonville, N. C., the board recommends that they be consolidated under the title "Inland waterway, Beaufort to Jacksonville, N. C.," with channel dimensions as follows: 100 feet wide and 3 feet deep at mean low water between Beaufort and Swansboro, thence 40 feet wide and 3 to 4 feet deep at mean high water to Craig Point, thence 40 feet wide and 3 feet deep at mean low water via Salliers Bay, Howards Bay, and New River to Jacksonville.

4. After due consideration of the above-mentioned reports, I concur in the views of the Board of Engineers for rivers and harbors, and therefore recommend legislation authorizing the modification of the New River improvement as specified by the board, and the consolidation of the projects for New River, and the waterways between New River and Swansboro, and between Beaufort and New River, under the title "Inland Waterway, Beaufort to Jacksonville, N. C.," with dimensions as stated above. No appropriation will be required to cover the estimated cost of original work if the funds already appropriated for the improvement of New River are

made available for the purpose. The cost of maintaining the entire waterway is estimated at $4,600 a year.

5. In making this recommendation I wish to invite attention to the fact that a waterway of such slight depth as that provided for the section between New River and Beaufort is entirely inadequate for a commerce of any magnitude, but in this case it appears to be justified as affording additional facilities for the exceptionally light-draft boats that are used at this locality.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

Third indorsement.]

The Board of Engineers for Rivers and Harbors,
July 12, 1916.

To the Chief of Engineers, United States Army:

1. The following report on New River, N. C., including inland waterways between Beaufort Harbor and New River, and between New River and Swansboro, is submitted under authority of that portion of section 14 of the river and harbor act approved March 4, 1915, which reads, "and the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. The improvement of these waterways has been carried on in recent years under three titles: (*a*) New River, (*b*) waterway between New River and Swansboro, (*c*) waterway between Beaufort Harbor and New River, i. e., portion between Beaufort and Swansboro. As these waterways are connected with each other, serve generally the same character of commerce, and really form one continuous water route, they are all considered by the board in a single report.

3. (*a*) *New River*. The existing project, adopted by the river and harbor act of June 25, 1910, provides for dredging a channel 200 feet wide and 5 feet deep at mean low water from the mouth of the river to Jacksonville, a distance of 23 miles, at an estimated cost of $6,700, with $800 annually for maintenance. The tidal range varies from 3½ feet at the inlet to 1 foot at the head of the marshes, a distance of about 2 miles. No work of construction has been done under this project. The total expenditures on all projects to June 30, 1915, were $82,142.60. The object of improvement at this locality has been to afford a navigable connection between the inlet and deep water in the river above the marshes. There was formerly an extensive traffic between this river and Wilmington by way of the inlet, but this no longer exists. All commerce that now goes out of the river goes through the inland waterway toward Swansboro. Therefore it appears that the commerce of New River will be adequately provided for by a suitable connection between these waterways. During recent years the total commerce of the river has averaged about 37,000 tons, of which only about 1,800 tons passed over the section of river where work is required.

The district officer presents three plans for the connection with the route to Swansboro, and because of its saving in distance, its being more easily navigated, and much less expensive to maintain, he recommends the Howards Bay-Salliers Bay route. He proposes a channel 4 feet deep at mean low water and 40 feet wide, at an estimated cost of $5,202, and $400 annually for maintenance, and he recommends that this improvement be adopted as a substitute for the present one. The funds available are sufficient to do the work proposed. The division engineer is in general accord with the views of the district officer.

Interested parties were notified of the present investigation and of the contemplated recommendations outlined above, and given an opportunity of submitting their views. Two communications[1] have been received; neither opposes the proposed modification of project.

As the alternative channel now proposed will serve a more useful purpose at less cost than the one provided for by the existing project the board concurs in favoring its adoption in place of the existing project, but it believes that a depth of 3 feet at mean low water, the same as the project depth on the eastern link of this waterway, is sufficient to accommodate the traffic, and it therefore recommends the work as proposed by the district officer, with the depth changed to 3 feet instead of 4 feet at mean low water.

4. (*b*) *Waterway between New River and Swansboro.*—The existing project, adopted by the river and harbor act of September 19, 1890, provides for a channel with a minimum width of 40 feet and a minimum depth of 3 to 4 feet at mean high water, at an estimated total cost of $43,000. The ordinary rise of tide is from 2½ to 4 feet at the inlets and about 1 foot at the points midway between them. The project was completed in December, 1915. The amount expended to June 30, 1915, was $42,021.65, of which $10,938.17 was for maintenance.

During the past five years the commerce has averaged about 13,000 tons, of which about one-half is timber, towed or barged. Gasoline boats of about 3 feet draft are used for this purpose. This waterway is a connecting link between New River and the waterway from Beaufort to Swansboro. The project is adapted to the locality which it serves, and the district officer recommends that it be continued without modification at an estimated cost of $1,200 a year. The division engineer concurs. The board is in general accord with the views of the district officer and the division engineer, but believes that this improvement should be consolidated with the adjoining improvements considered herein and as recommended later in this report.

5. (*c*) *Waterway between Beaufort Harbor and New River*, i. e., portion between Beaufort and Swansboro. The existing project, adopted by the river and harbor act of August 5, 1886, provides for a channel 100 feet wide and 3 feet deep at ordinary low water between Beaufort and Swansboro, at an estimated cost, as subsequently modified, of $71,040. The tidal range is about 3½ feet at the inlets and 1 foot at a point midway between them. The project was completed in May, 1915. The amount expended to June 30, 1915, was $83,645.66, of which $6,645.66 was for maintenance.

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[1] Not printed.

During the past five years the commerce has averaged about 46,000 tons, the principal items being lumber, timber, and fish. The project is adapted to the locality which it serves, and the district officer recommends its continuance without modification at an estimated cost of $3,000 a year. The division engineer concurs. The board is in general accord with the views of the district officer and the division engineer, but believes that this improvement should be consolidated with the others considered in this report.

6. These three waterways are essentially parts of one through waterway between Beaufort and Jacksonville, N. C. The project depth for the intermediate section, Swansboro to New River, is less than the project depth for the adjacent sections, and while it would be of advantage to have one depth throughout, this would be unduly expensive. Moreover, this section is of such length that it can be passed over on one tide and therefore commerce will be fairly served by retaining that depth. To sum up the foregoing, the board recommends modification of the existing project for the improvement of New River and the consolidation of the three improvements considered in this report under the title "Inland waterway, Beaufort to Jacksonville, N. C.," with channel dimensions as follows: 100 feet wide and 3 feet deep at mean low water between Beaufort and Swansboro, thence 40 feet wide and 3 to 4 feet deep at mean high water to Craig Point, thence 40 feet wide and 3 feet deep at mean low water via Salliers Bay, Howards Bay, and New River to Jacksonville. No appropriation will be needed to cover the estimated cost of original work, as the funds available are sufficient for this purpose. The estimated cost of maintenance for the entire waterway is $4,600 a year.

For the board:

FREDERIC V. ABBOT,
Colonel, Corps of Engineers,
Senior Member of the Board.

REEXAMINATION OF NEW RIVER, N. C.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., March 22, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Abandonment or modification of existing river and harbor projects, New River, N. C.

1. This is a report on New River, N. C., submitted in compliance with instructions contained in fourth indorsement, office of the Chief of Engineers, and pursuant to the following provision of the river and harbor act of March 4, 1915: "And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. New River is a short stream lying almost wholly within Onslow County, N. C. It flows into the Atlantic Ocean through New River Inlet, about midway between Cape Lookout and Cape Fear. Its

total length is about 52 miles and it has a basin of about 500 square miles. At Jacksonville, 23 miles above its mouth, the width is 150 to 200 feet. At about 1 mile below Jacksonville it widens out very considerably and from this point to a point about 1½ miles from its mouth it varies in width from 1,000 to 10,000 feet, with a channel depth of 5 to 8 feet or more. From its mouth to a point about 1½ miles above, it is obstructed by an interior delta formed by sand washed through the inlet by storms which causes extensive marshes in the river and confines the flow of the river and tide to several narrow channels connecting the broad portions of the river with the ocean through the inlet. All work of improvement has been confined heretofore to this "interior delta" near the mouth of the river. The bed of the river in this section is composed of sand, silt, mud, and accumulated beds of oyster shells known as "oyster rocks." There are no bridges on the stream below Jacksonville.

3. An examination was made of this stream in 1836 which resulted in appropriations by Congress in the years 1836, 1837, and 1838 for "removing the oyster shoal in New River by means of the dredging machine ——."

4. The next examination of this stream, authorized by Congress, was made in 1882. (H. Doc. 169, 47th Cong., 1st sess.) The report was favorable and stated that any further improvement should be confined to the widening and straightening of the river channel to 150 feet width and 5 feet depth, but it was stated that the cost, which ordinarily would be about $23,000, would run up to $40,000 on account of the remote location, removal of oyster rock, etc. The improvement proposed covered a channel about 7,000 feet long near the mouth of the river by way of what is now known as the Western Channel.

5. Another examination was made in 1903 in compliance with the river and harbor act of June 13, 1902. It was favorable and recommended the construction of an oyster-shell dike to restore the 4-foot channel depth in the Western Channel at a cost not to exceed $3,200, the balance then available to the credit of the appropriation.

6. In 1907–1908 an examination and survey was made in compliance with the river and harbor act of March 2, 1907, with a view to obtaining a depth of 5 feet from its mouth to Jacksonville. (H. Doc. 1085, 60th Cong., 2d sess.) The report was favorable and recommended a channel 200 feet wide and 5 feet deep through the Western Channel, at a total estimated cost of $6,700.

7. In 1913 a preliminary examination was made of this stream in compliance with the river and harbor act of July 25, 1912, which directed an examination of "New River, N. C., from Jacksonville as far up as practicable." (H. Doc. 277, 63d Cong., 1st sess.) The report was unfavorable.

8. Under the project of 1836, it is believed that a channel about 50 feet wide was dredged over a part of what is now known as the Western Channel. The records, however, are incomplete. Nothing further was done by the Government, apparently, from about 1839 to 1882, when the project for a channel 5 feet deep by 150 feet wide by way of the Western Channel was adopted. No work was done under this project until 1886. Before actual work began, however, the location of the channel was modified somewhat to provide a

straighter and more direct channel involving two cuts, one through Wrights Island for the purpose of straightening that portion of the river near the inlet, and one called Cedar Bush Marsh Cut, connecting the upper river with the inlet and eliminating the Western Channel route. (See Annual Report Chief of Engineers for 1886.)

9. The Wrights Island Cut was dredged to project width and depth and this depth or greater has since been self-maintained. The Cedar Bush Marsh Cut was dredged to a width of 40 feet and depth of 3.5 feet in 1886. Some scour occurred in 1886–1887. Dredging was done in 1887–1888, and, as a result, an average depth of 4½ feet was secured with 4 to 5 feet at low water everywhere except at the lower end, where it was about 3.1 feet. The width was 40 feet. No further dredging has been done in this cut.

10. The Cedar Bush Marsh Cut had shoaled at the upper end by 1893, so that the available depth was only 1½ feet. This channel was therefore abandoned in 1894 and further work applied on the lower part of what is now called the Western Channel, to secure a channel 4 feet deep. A timber dike was built which succeeded in securing this depth. This dike was experimental and was soon destroyed by teredo. In 1905 this dike was replaced by one of oyster shells and it has succeeded in securing and maintaining a channel of at least 4 feet depth at low water and about 75 feet wide below the upper end of the dike.

11. The present project was adopted by the river and harbor act of June 25, 1910. It provides for a channel 200 feet wide and 5 feet deep between the mouth of the river and Jacksonville. This is to be effected by dredging a channel 200 feet wide and 5 feet deep at mean low water by way of the Western Channel, through the marsh near the mouth of the river, in accordance with the plan outlined in House Document 1085, Sixtieth Congress, second session, at an estimated cost of $6,700. This projected cut extends from a point about 1,500 feet above the inlet to a point above the marshes. From this latter point to Jacksonville no dredging is required. The estimate was for 37,183 cubic yards at 18 cents. The work was advertised and proposals opened October 20, 1910. The low bid, being $1 for rock and 18 cents for ordinary material, was rejected as excessive. The work was again advertised and proposals opened August 28, 1913, at which time the only bid received was 29 cents per cubic yard, not including rock. This was also rejected as excessive. In 1913 an inexpensive survey and a rough estimate were made which indicated that the yardage to be removed was much in excess of that estimated in 1908. In view of the fact that the funds on hand were wholly insufficient, that the cost of the work would be materially increased if it did not progress continuously, and that the cost of the work shown by the new survey did not seem to be justified by the commercial benefits, no work has been done pending a report of the facts to Congress.

12. A careful resurvey of the Western Channel and the Cedar Bush Marsh Channel was made in February, 1916, and a map showing the results of this survey accompanies this report. To secure the project width and depth with 1 foot overdepth by the Western Channel will require the removal of 180,940 cubic yards of mud, sand, and oyster-shell rock at a unit cost of 12 cents per yard, or a

total cost of $21,712.80. This leaves a deficiency of $16,012.80 to be appropriated to complete the project.

13. The commerce for this stream for the past 10 years has been reported as follows:

Year.	Tons.	Value.
1905	15,798	$410,595
1906	13,660	500,504
1907	24,803	477,278
1908	4,487	189,360
1909	44,320	379,667
1910	31,301	310,890
1911	36,257	332,110
1912	37,868	290,760
1913	42,687	301,084
1914	37,198	191,128

Table I, accompanying this report, shows the details of the commerce for the year 1914.

14. Prior to 1890 an extensive commerce was carried on between Jacksonville and Wilmington by means of small schooners going out New River Inlet, but in 1891 a railroad was built from Wilmington to Jacksonville, which was extended to Newbern in 1893. It will be noted from Table I that timber going to the mills at Jacksonville constitutes about 93 per cent of the total commerce and that this does not pass over that portion of the river requiring work under the project. Of the remaining 2,628 tons of freight, 1,846 tons passed over the section on which work is required. It is reported that there is some indication of a tendency for interchange of commerce by water between Swansboro and the railroad at Jacksonville. So far as known to this office no commerce whatever passed through the inlet to the sea. All commerce passing out of the river at the lower end goes through the inland waterway toward Swansboro.

15. The width of the present project channel was recommended "in order to allow the necessary increase in the volume and velocity of the tidal flow to maintain a depth of 5 feet on the bar." As no commerce now passes over the bar, there is no longer this necessity for a width as great as 200 feet. Since all commerce passing out of New River uses the inland waterway from New River to Swansboro, it would seem that the present project depth of 5 feet is unnecessary, as the present project depth for this inland waterway is 4 feet at high water.

16. A comparison of the cost and extent of the present adopted project with the benefits to be derived and probable use to be made of it indicates clearly that the project should be modified. In considering any modification of the project the fundamental condition should obtain that any improvement of New River should be made with a view to connecting it with the inland waterway between New River and Swansboro so as to form a continuous waterway between Swansboro and Jacksonville. No consideration should be given to New River Inlet with a view to securing coastwise traffic, as this would cost out of all proportion to the commerce which might be expected to develop. The necessity for this navigation does not exist now as it did before the railroad was extended to Jacksonville.

17. Three different modifications have been considered as follows:

(*a*) A channel 4 feet deep at mean low water and 100 feet wide by way of the Western Channel. The route of this channel is marked A—B—C on the accompanying map. It is the same as the route of the present approved project.

(*b*) A channel 4 feet deep at mean low water by way of Cedar Bush Marsh, 40 feet wide through the marsh and 100 feet wide above the marsh. The route of this channel is marked A—D on the accompanying map.

(*c*) A channel 4 feet deep at mean low water and 40 feet wide by way of Howards and Salliers Bays. The route of this channel is marked E—F on the accompanying map. "F" is at the junction of this route with the inland waterway between New River and Beaufort. All of the above channels will provide a connection between New River and the inland waterway as shown on the accompanying map. The depth of 4 feet at mean low water is provided so as to permit vessels to traverse this portion of the route from New River to Swansboro at low water so as to make the shallow portion of the inland waterway channel at high water.

18. The estimates, including 1 foot overdepth, are as follows:

Modification.	Cubic yards dredged.	Unit cost.	Total cost.	Yearly maintenance.
		Cents.		
(*a*) Par. 17	33,450	22	$7,359	$1,500
(*b*) Par. 17	48,700	25	4,675	1,000
(*c*) Par. 17	57,800	9	5,202	400

There is a marked difference in unit price for the three modifications. This results from the fact that modifications (*a*) and (*b*) must be done by a pipe-line dredge and the material deposited a considerable distance from the channel while the modification (*c*) can be done by a bucket dredge and the material banked directly alongside the channel. The pipe-line dredge of least draft in this district has a draft of 5 feet and considerable extra material would necessarily have to be removed to float the dredge and also to allow her to clear herself. The bucket dredge available draws 4 feet and is therefore perfectly adapted to work under modification (*c*). The figures in the above table for yardage show the material to be removed from section and from 1 foot overdepth. The unit prices allow in each case for the extra or "non-pay" yardage as well as for difficulties due to strong currents which are encountered in the channels covered by modifications (*a*) and (*b*). It is to be noted that the unit prices estimated under modifications (*a*) and (*b*) are less than that bid on sealed proposals for this work in 1913. The unit price estimated under modification (*c*) is taken from the results of experience with similar work in this district.

19. The Western Channel route covered by modification (*a*) follows the route of the present project. The tidal currents up as far as the oyster-shell dike are very strong. After passing the dike and entering the broad basin above the marshes the currents are much weaker and it is probable that much deterioration of the dredged channel will occur. In addition to this, the channel is very crooked and navigation would be comparatively difficult even with the 100-foot width provided. It is believed that no less width than 100 feet should be considered for this route.

20. The Cedar Bush Marsh Channel has the advantage of being perfectly straight and therefore easily navigated. It has the great disadvantage, however, of being expensive to maintain. As experi-

ence has demonstrated and as might be expected, shoaling will occur at the upper end of the cut where the broad waters above the marshes act as a settling basin. For this reason a channel 100 feet wide above the marshes has been estimated for.

21. A channel by way of Howards and Salliers Bays, covered by modification (*c*), paragraph 17, and as shown on the map accompanying this report, need not be more than 40 feet wide as this route is not subject to currents and its long tangents would be easily navigated especially if the material is banked on one side, thus providing a guide for boats. It is believed that maintenance cost of such a channel would be low compared with the other routes considered since there would be very little movement of the bottom in the quiet waters traversed and settlement of suspended material would be small.

22. Considered as a connection between New River and the inland waterway to Beaufort, the route by Howards Bay and Salliers Bay is about 2 miles shorter than by the Western Channel route and over 1½ miles shorter than by the Cedar Bush Marsh route. It is cheaper than the Western Channel route, more easily navigated, and much less expensive to maintain. While it is a little more expensive in first cost than the Cedar Bush Marsh route, it is much less expensive to maintain and is more easily navigated. From information in this office, it is believed that considerable commerce in timber will be developed between mills on New River and points along the inland waterway in case a channel easy to navigate with gasoline launches and tows be provided for getting into New River by way of Howards and Salliers Bays.

23. It is recommended, therefore, that the present project be modified so as to provide for a channel 4 feet deep at mean low water and 40 feet wide between Jacksonville and the New River-Beaufort inland waterway near Craig Point by way of Howards and Salliers Bays, as shown on the map accompanying this report. Sufficient funds are on hand to complete this modification as estimated in paragraph 18 of this report.

24. A map accompanies this report made from surveys by this office in 1913, 1914, and 1916. To avoid confusion, only a small percentage of the soundings taken have been placed on the map. Those shown are representative.

25. The terminal facilities on this stream are described in House Document No. 226, Sixty-third Congress, first session, page 665, and are considered adequate.

26. There are no questions of water power, or other subjects, so related to the project that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interest of navigation.

C. S. Ridley,
Captain, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, SOUTHEAST DIVISION,
March 31, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded.

2. Three modifications of the present project for New River, N. C., are submitted for consideration by the district engineer officer, each complying with the condition of connecting with the inland waterway from New River to Swansboro. Previous projects were based on the use of New River Inlet but at present no commerce whatever passes through this inlet.

3. From paragraph 14 of the within report, it appears that the total commerce using the portion of the waterway needing improvement is only 1,846 tons. The interest at 3 per cent on the first cost and estimated annual maintenance makes the cost per ton about 30 cents. This appears to me to be rather high and I am not wholly convinced that much increase in tonnage can be expected in the immediate future. Considering, however, the lack of other means of transportation along or near the waterways between Swansboro and Jacksonville, and in view of the fact that funds are on hand and the total cost small, it might be well to adopt the modification proposed by the district engineer officer, with a view to its maintenance for a few years. If commerce does not respond appropriate action should then be taken.

4. Subject to the above remarks, I concur in the recommendation of the district engineer officer as expressed in paragraph 23.

W. C. LANGFITT,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors, see p. 3.]

TABLE I.—*Commercial statistics, New River, N. C., for 1914.*

Commodities.	Amount.		Valuation.
	In customary units.	In short tons.	
UPSTREAM.			
Cattle..........head..	50	13	$1,300
Cotton..........bales..	55	14	3,570
Cotton seed..........tons..	11	11	220
Clams..........bushels..	2,275	114	2,280
Empty oil barrels..........number..	25	1	25
Eggs..........crates..	125	3	900
Fish, salt..........barrels..	1,275	64	6,400
Fish, fresh..........boxes..	3,200	320	32,000
Hogs..........head..	200	10	2,000
Lumber..........M ft. b. m..	7	14	105
Oysters..........bushels..	2,400	96	2,400
Poultry..........head..	400	1	200
Railroad iron..........tons..	240	240	7,200
Timber..........ft. b. m..	11,5 3,234	34,570	86,425
Watermelons..........number..	2,000	20	300
Total..........	....	35,491	145,325

TABLE I.—*Commercial statistics, New River, N. C., for 1914*—Continued.

Commodities.	Amount.		Valuation.
	In customary units.	In short tons.	
DOWNSTREAM.			
Brick...number..	6,700	17	$851
Cottonseed hulls...tons..	30	30	240
Cottonseed meal...do....	9	9	243
Crossties...number..	11,360	710	5,680
Dry goods...tons..	6	6	4,800
Fertilizer...do....	180	180	5,400
Furniture...do....	1	1	125
Grain...bushels..	2,210	55	1,700
Gasoline...barrels..	174	30	1,410
Groceries...tons..	170	170	17,000
Hardware...do....	32	32	4,480
Hay...do....	67	67	1,608
Ice...do....	6	6	42
Kerosene...barrels..	150	27	720
Lime...do....	30	4	25
Lumber...M ft. b. m..	131	262	1,965
Potatoes, Irish...bushels..	55	2	66
Salt...sacks..	450	32	256
Shingles...number..	13,000	7	70
Timber...M ft. b. m..	20	60	150
Total...	....	1,707	45,803
Total upstream...	....	35,491	145,325
Total downstream...	....	1,707	45,803
Grand total...	....	37,198	191,128

REEXAMINATION OF WATERWAY BETWEEN NEW RIVER AND SWANSBORO, N. C.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., February 29, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Abandonment or modification of river and harbor projects: Waterway between New River and Swansboro, N. C.

1. The following report for the waterway between New River and Swansboro, N. C., is submitted in compliance with the instructions contained in fourth indorsement, 78991/249, Office of the Chief of Engineers, and pursuant to the following provision of the river and harbor act of March 4, 1915: "And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. Between Bogue Inlet and New River Inlet there is a continuous stretch of marine marsh separating the mainland on one side from the barrier reef or island of sand on the ocean side. This marsh is about 3 miles wide at Swansboro, which is on the mainland opposite Bogue Inlet. It narrows down as it approaches New River Inlet until at a point about 4 miles from the inlet it is only about 500 feet wide. From this point to New River it widens out somewhat. The distance by air line from Swansboro to New River is about 17 miles.

This marsh, especially between Swansboro and Browns Inlet, is intersected in all directions by numerous tortuous tidal channels of various widths and depths. The tidal range near the inlets is about 3½ feet, but midway between the inlets this decreases to 1 foot or less. The depths at low water in these channels vary from 6 inches to 15 feet, the latter depth being found near the inlets in places.

3. Four inlets connect this waterway with the Atlantic Ocean. The navigable condition of these inlets is constantly changing, due to the shifting bar at the mouth of each. Bogue Inlet, opposite the town of Swansboro, now has about 6 feet on the bar at low water. It is used by fishing and pleasure boats only. During 1915 between 30 and 40 yachts passed through on the way between northern points and Florida. Bear Inlet has from 6 to 8 feet on the bar. It is used regularly by two fishing boats and occasionally by about 12 others. Browns Inlet has from 1 to 2 feet on the bar at low water. There is no traffic through this inlet. New River Inlet has about 5 feet on the bar at low water. This inlet is used occasionally by fish boats operating between Bogue Inlet and points further south when weather conditions make it necessary for them to secure harbor.

4. Several small creeks flow into the marshes from the mainland, the principal ones being Queens Creek, which connects with the ocean through Bogue Inlet, and Bear Creek, which reaches the ocean through Bear Inlet.

5. Examinations were made of this waterway in 1882 and in 1884 in connection with the waterway between Beaufort Harbor and New River (see p. 1055, Annual Report of Chief of Engineers, 1884, and pp. 1133–39, Annual Report of Chief of Engineers, 1885). Both reports were unfavorable.

6. A separate examination was made of this waterway between New River and Swansboro in 1889, in compliance with the river and harbor act of August 11, 1888. This report was favorable. (Report of the Chief of Engineers for 1889, p. 1124.) The district officer recommended, as a result of his inspection, that the route be "improved so as to allow a 3 to 4 foot draft navigation at high tide from Swansboro to New River, at a total expense of $43,000."

7. The present project, adopted by the river and harbor act of September 19, 1890, is to provide a channel between Swansboro and New River by dredging to a minimum width of 40 feet and minimum depth of from 3 to 4 feet at high water. Until June 13, 1906, no dredging had ever been done, as an act of the General Assembly of North Carolina had incorporated the Wrightsville and Onslow Navigation Co., with the exclusive right to navigate said waterway. On February 6, 1905, the survivors of the incorporators declared that this franchise had, to all intents and purposes, been abandoned. Work was commenced in June, 1906, and the project was completed in December, 1915. Further work will be for maintenance. No map accompanies this report, but reference is made to map submitted this date with my report to the Chief of Engineers on the waterway between Beaufort Harbor and New River. This map shows the present route followed by this waterway between Swansboro and New River.

8. The commerce for this waterway between Swansboro and New River for the past 10 years is shown in the following table:

Year.	Tons.	Valuation.
1905	1,383	$61,340
1906	6,686	355,950
1907	5,644	299,887
1908	5,208	238,735
1909	4,590	151,520
1910	14,013	185,795
1911	16,598	275,806
1912	17,474	214,413
1913	8,987	164,697
1914	9,369	113,219

The details of the 1914 commerce are shown in Table I accompanying this report. It will be noted that of the 1914 commerce about 77 per cent is timber. This timber must be towed or barged, as there is no current, and for this purpose gasoline boats are used with about 3 feet draft.

9. Swansboro, the only town on this waterway, has a population of about 600. A large part of the population is employed in fishing, clamming, and boating. The Swansboro Land & Lumber Co. operates a lumber mill with a capacity of 30,000 feet per day. They receive all of their timber by tram road and ship all of their lumber by water through Bogue Sound. Swindell & Sons, of Swansboro, operate a lumber mill with a capacity of 15,000 feet per day. They receive all of their timber by water from nearby points and ship all of their lumber by water through Bogue Sound. There is a modern 35-room hotel at Swansboro. There are 12 general stores, 2 drug stores, a small marine railway, and machine shop. On the waterway 1 mile west of Swansboro is a cotton gin and grist mill. At Queens Creek, 2 miles west of Swansboro, is a cotton gin and turpentine distillery. At Bear Creek, 4 miles west, is a fish-fertilizer factory, handling about 1,500,000 fertilizer fish, an annual output of about 100 tons of fertilizer, and 50 barrels of oil, valued at $7,950; and a lumber mill with a capacity of from five to ten thousand feet per day.

10. This waterway is a connecting link between New River and the inland waterway from Swansboro to Beaufort, giving a through inland route for small boat traffic between Beaufort and Jacksonville, N. C. It serves a very isolated section of the country, as the entire waterway is far removed from any railroad. It is believed that commerce will grow and that the waterway, if maintained, will have considerable effect on the development of the territory which it serves. The estimated annual cost of maintenance is $1,200.

11. Some consideration has been given to an increase in the project making it 4 feet deep at low water, because some of the boats using the waterway are required to time their trips so as to cross certain places at high water. Doubtless this would result in considerable added convenience to traffic, and possibly some increase in commerce would accrue from such a change, but it is believed that the present or prospective commerce does not warrant any additional expenditures at this time other than maintenance.

12. It is recommended, therefore, that the present project be neither modified nor abandoned.

13. Existing terminal facilities, while few in number and small in extent, are considered adequate for the commerce carried on the waterway. There are 23 wharves at or near Swansboro, all of timber construction, with a total frontage of about 500 feet. Eleven of these have warehouses aggregating 9,800 square feet of floor space, one is a marine railway, and one is a public wharf belonging to the town of Swansboro. None of these wharves is provided with mechanical equipment for unloading or physical connection with railroads.

14. There are no questions of water power or other subjects so related to the project that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interest of navigation.

C. S. Ridley,
Captain, Corps of Engineers.

[First indorsement.]

Office Division Engineer,
Southeast Division,
March 2, 1916.

To the Chief of Engineers, United States Army.

1. Forwarded.

2. For the reasons summarized in paragraph 10 of the within report I concur in the recommendation of the district officer.

W. C. Langfitt,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors see p. 3.]

Table I.—*Commercial statistics for waterway between New River and Swansboro for calendar year 1914.*

Commodities.	Amount.		Valuation.
	In customary units.	In short tons.	
GOING WEST.			
Brick........number..	5,100	13	$39.00
Coal........tons..	14	14	56.00
Cattle........head..	50	13	1,300.00
Cotton........bales..	35	9	2,295.00
Clams........bushels..	200	10	200.00
Cotton seed........tons..	6	6	120.00
Cottonseed hulls........do....	42	42	336.00
Cottonseed meal........do....	53	53	1,431.00
Dry goods........do....	7	7	5,250.00
Eggs........crates..	35	1	300.00
Empty oil barrels........number..	30	1	25.00
Fish, salt........barrels..	500	25	2,500.00
Fertilizer fish........number..	1,000,000	500	1,500.00
Fertilizer........tons..	165	165	4,950.00
Gasoline........barrels..	95	17	799.00
Grain........bushels..	2,636	66	2,112.00
Groceries........tons..	148	148	14,800.00
Hogs........head..	150	8	1,600.00
Hay........tons..	24	24	576.00
Hardware........do....	19	19	2,000.00

TABLE I.—*Commercial statistics for waterway between New River and Swansboro for calendar year 1914*—Continued.

Commodities.	Amount.		Valuation.
	In customary units.	In short tons.	
GOING WEST—continued.			
Ice....tons..	4	4	$28.00
Kerosene....barrels..	23	4	108.00
Lime....do....	15	2	14.00
Lumber....feet b. m..	35,802	72	540.00
Machinery....tons..	6	6	600.00
Oysters....bushels..	200	8	50.00
Poultry....head..	1,050	2	400.00
Potatoes, Irish....bushels..	33	1	33.00
Salt....sacks..	297	21	168.00
Soft drinks....crates..	151	9	288.00
Shingles....number..	8,300	4	40.00
Watermelons....do....	2,000	20	300.00
Total....	....	1,294	45,418.00
GOING EAST.			
Brick....number..	5,000	13	39.00
Cotton....bales..	295	74	18,870.00
Cotton seed....tons..	156	156	3,120.00
Cottonseed hulls....do....	25	25	200.00
Cottonseed meal....do....	10	10	270.00
Clams....bushels..	900	45	900.00
Dry goods....tons..	8	8	6,000.00
Empty oil barrels....number..	25	1	25.00
Furniture....ton..	1	1	125.00
Fish, fresh....boxes..	449	45	4,500.00
Fish, salt....barrels..	1,113	56	5,600.00
Fertilizer....tons..	72	72	2,160.00
Groceries....do....	10	10	1,000.00
Grain....bushels..	50	1	32.00
Hay....tons..	10	10	24.00
Hardware....do....	5	5	700.00
Kerosene....barrels..	5	1	27.00
Lime....do....	30	4	28.00
Lumber....feet b. m..	68,362	137	1,027.50
Machinery....tons..	10	10	1,000.00
Potatoes, Irish....bushels..	35	1	33.00
Rosin....barrels..	675	108	2,268.00
Salt....sacks..	70	5	40.00
Timber....feet b. m..	2,417,614	7,253	18,132.50
Turpentine, spirits....barrels..	106	24	1,680.00
Total....	....	8,075	67,801.00
RECAPITULATION.			
Going west....	....	1,294	45,418.00
Going east....	....	8,075	67,801.00
Grand total....	....	9,369	113,219.00

REEXAMINATION OF WATERWAY BETWEEN BEAUFORT HARBOR AND NEW RIVER, N. C.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., February 29, 1916.

From: The District Engineer Officer.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).
Subject: Abandonment or modification of river and harbor projects; waterway between Beaufort Harbor and New River, N. C.

1. The following report for the waterway between Beaufort Harbor and New River, N. C., covering that portion of the waterway between

Beaufort and Swansboro, is submitted in compliance with instructions contained in fourth indorsement, Office of the Chief of Engineers, and pursuant to the following provisions of the river and harbor act of March 4, 1915: "And the Chief of Engineers is directed to make a report upon any other projects, river or harbor, the further improvement of which under present conditions is undesirable, or in which modifications of the plans or projects should be made."

2. Bogue Sound is a shallow body of water extending from Beaufort, N. C., to Swansboro, N. C. It has an outlet to the ocean through Beaufort Inlet at the eastern end and through Bogue Inlet at its western end. It varies from two-thirds mile to about 3 miles in width and in its natural state from one-half foot to 15 feet in depth, the average depth being about 2 to 4 feet at mean low water. It is separated from the Atlantic Ocean throughout its length by a barrier reef or island of sand such as is commonly found on this part of the Atlantic coast. Between Swansboro and a point 4 miles east of Swansboro the sound consists of marshes through which there is a perfect maze of intersecting channels of various widths and depths. White Oak River empties into the sound at Swansboro, which is on the mainland opposite Bogue Inlet. The tidal variation is about 3½ feet at the two inlets and about 1 foot midway between them.

3. The waterway under improvement traverses Bogue Inlet between Beaufort Harbor and Swansboro, and is about 30 miles long. It has a minimum depth of 3 feet at mean low water and a width of 100 feet. While the title of this waterway is "Waterway between Beaufort Harbor and New River, N. C.," no work is done west of Swansboro under allotments for this waterway, and there is a separate project covering that portion of the waterway between Swansboro and New River.

4. The first preliminary examination of this waterway was made in 1882, in compliance with the river and harbor act of August 2, 1882. (P. 1055, Annual Report of Chief of Engineers, 1884.) No contemplated depth or object was stated. The report was unfavorable.

In 1884–85 a preliminary examination and survey were made of "Bogue Sound, between New River and Beaufort, N. C.," in compliance with the river and harbor act of July 5, 1884. (Pp. 1133–1139, Annual Report of the Chief of Engineers, 1885.) The report was favorable so far as to recommend a waterway between Swansboro and Beaufort Harbor 3 feet deep at low water and 100 feet wide. In the survey report the district officer submits an estimate of $6,000 for "a channel 100 feet wide and 3 feet deep," but recommended "at least $10,000 as an amount that can profitably be expended during the coming fiscal year for the establishment by dredging of a continuous channel of at least 3 feet depth at ordinary low water through Bogue Sound from Beaufort Harbor to Swansboro."

5. The present project is the original project adopted by the river and harbor act of August 5, 1886, to provide a channel 100 feet wid
and 3 feet deep at ordinary low water between Beaufort Harbor ar
Swansboro. Work was begun in 1887 and by 1897 a channel
feet wide and 3 feet deep was secured. Since that time, w
appropriations were available, the work of improvement con

in widening this channel to 100 feet, the project being finally completed in May, 1915. Further work will be for maintenance.

6. The commerce for this waterway, as reported for the past 10 years, is shown in the following table:

Year.	Tons.	Valuation.
1905	30,548	$1,290,715
1906	29,602	1,634,600
1907	29,174	1,156,164
1908	27,372	1,097,206
1909	25,347	552,655
1910	33,260	791,740
1911	55,825	956,571
1912	62,111	929,418
1913	44,089	770,006
1914	34,366	503,617

The details of the commerce for 1914 are shown in Table I accompanying this report. Of the 1914 commerce, lumber constitutes 38 per cent, timber 29 per cent, and fish 20 per cent. The lumber is brought in lighters from Swansboro and loaded into barges in Beaufort Harbor for shipment to northern points. The falling off of commerce in 1914 is believed to be due in a great part to the general depression in the South caused by the European war.

7. This waterway is an important factor in the commercial life of the town of Swansboro and the country along which it passes. Swansboro is at least 20 miles from any railroad by wagon road, and therefore has no certain way of sending out and bringing in supplies except through the inland waterway. By means of the waterway they are enabled to ship cheaply to and from Beaufort, where connection may be had with the Norfolk Southern Railroad or with the barge line to Norfolk or southern ports. Since opening up the inland waterway to Beaufort, no commerce passes through Bogue Inlet with the exception of fishing and pleasure boats. The freight and insurance rates by barge from Beaufort Harbor to northern points is very much less than the rates from either Bogue or Beaufort Inlets, on account of the dangers of Hatteras Shoals.

8. Swansboro has a population of about 600. A large part of the population is employed in fishing, clamming, and boating. The Swansboro Land & Lumber Co. operates a lumber mill with a capacity of 30,000 feet per day. They receive all of their timber by tram road and ship all of their lumber by water through Bogue Sound. Swindell & Sons, of Swansboro, operate a lumber mill with a capacity of 15,000 feet per day. They receive all of their timber by water from near-by points and ship all of their lumber by water through Bogue Sound. There is a modern 35-room hotel at Swansboro. There are 12 general stores, 2 drug stores, a small marine railway, and machine shop. The fish dealers at Morehead City send boats to Swansboro and buy the fish, clams, etc., that are caught near by
nd take them to Morehead for packing and shipping. There is a
ular gas-boat line between Swansboro and Morehead, making 3
Su nd trips per week. There are 3 gas boats that make regular weekly
W between Swansboro and Newbern. Most of the commerce is
1. d on flats towed by gasoline boats.
and N

9. The annual cost of maintaining this waterway in the future is estimated at $3,000, and it is believed that this is justified by the amount of commerce carried and the character of the territory it serves. No less depth should be specified, because the boats engaged in the traffic require the project depth. No less width should be specified, because in a waterway of this character through a broad sheet of water, a narrower channel would be too difficult to follow. It would also require too frequent dredging, thereby increasing the maintenance cost.

10. I recommend, therefore, that no modification be made of the present project.

11. In regard to terminal facilities there are 30 wharves between Morehead City and Swansboro. Three of these belong to fish factories and are equipped with mechanical devices for handling. Two wharves, that of the Canfield Lumber Co. and that of the Carolina Naval Stores Co., have physical connection with the Norfolk Southern Railraod. Twelve wharves have warehouses with floor space approximating 3,700 square feet. The remaining wharves are small and in fair to poor condition, built of timber with plank decking. There are 23 wharves at or near Swansboro, all of timber construction, with a total frontage of about 500 feet. Eleven of these have warehouses aggregating 9,800 square feet of floor space, one is a marine railway and one is a public wharf belonging to the town of Swansboro. None of these wharves is provided with mechanical equipment for unloading or physical connection with railroads. These terminals are considered adequate for the present commerce.

12. There are no questions of water power or other subjects so related to the project that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interest of navigation.

13. A map accompanies this report showing the present route of the waterway.

C. S. RIDLEY,
Captain, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, SOUTHEAST DIVISION,
March 2, 1916.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. Forwarded.
2. For the reasons summarized in paragraph 9 of the within report, I concur in the recommendation of the district officer.

W. C. LANGFITT,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors see p. 3.]

TABLE I.—*Commercial statistics for waterway between Beaufort Harbor and Swansboro for year 1914.*

Commodities.	Amount.		Valuation.
	In customary units.	In short tons.	
EASTBOUND.			
Clams........bushels..	8,207	160	$3,200.00
Cotton........bales..	548	137	34,935.00
Cotton seed........tons..	342	342	6,840.00
Cattle........head..	126	32	3,200.00
Empty oil barrels........number..	156	6	150.00
Eggs........crates..	141	4	1,200.00
Furniture........tons..	2	2	250.00
Fertilizer........do....	248	248	7,440.00
Fish oil........barrels..	113	28	1,960.00
Fish, salt........do....	1,232	62	6,200.00
Fish, fresh........boxes..	12,000	1,200	120,000.00
Hogs........head..	228	11	2,200.00
Hardware........tons..	10	10	1,400.00
Ice........do....	2	2	14.00
Lumber........feet b. m..	6,639,246	13,278	99,585.00
Machinery........tons..	10	10	1,000.00
Oysters........bushels..	1,020	41	256.25
Poultry........head..	1,430	3	600.00
Rosin........barrels..	675	108	2,268.00
Salt........sacks..	44	3	24.00
Turpentine, spirits........barrels..	106	24	1,680.00
Tobacco........pounds..	5,800	3	1,160.00
Timber........feet b. m..	8,318,581	9,956	24,890.00
Watermelons........number..	42,716	427	6,405.00
Wood........cords..	18	18	72.00
Total........	....	26,115	326,929.25
WESTBOUND.			
Brick........number..	66,210	166	496.00
Cement........tons..	8	8	68.00
Coal........do....	32	32	128.00
Cottonseed hulls........do....	116	116	928.00
Cottonseed meal........do....	117	117	3,159.00
Dry goods........do....	27	27	20,250.00
Fertilizer........do....	640	640	19,200.00
Fertilizer fish........number..	11,262,000	5,631	16,893.00
Fish, fresh........boxes..	10	1	100.00
Furniture........tons..	37	37	4,625.00
Gasoline........barrels..	507	89	4,183.00
Groceries........tons..	664	664	66,400.00
Grain........bushels..	7,927	198	6,336.00
Hay........tons..	60	60	1,440.00
Horses........head..	6	3	600.00
Hardware........tons..	187	187	26,180.00
Ice........do....	22	22	154.00
Kerosene........barrels..	268	40	1,325.00
Lime........do....	54	7	49.00
Lumber........feet b. m..	44,426	89	667.50
Machinery........tons..	16	16	1,600.00
Potatoes, Irish........bushels..	254	8	264.00
Salt........sacks..	492	84	272.00
Shingles........number..	12,300	6	60.00
Soft drinks........crates..	627	39	1,248.00
Vegetables........packages..	40	2	50.00
Wood........cords..	3	3	12.00
Total........	....	8,251	176,687.5
RECAPITULATION.			
Eastbound........	....	26,115	326,929.2
Westbound........	....	8,251	176,687.5
Grand total........	....	34,366	503,616.7

64TH CONGRESS, } HOUSE OF REPRESENTATIVES. { DOCUMENT
2d Session. } { No. 1792.

FLOOD PROTECTION AND PREVENTION.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON PRELIMINARY EXAMINATIONS OF CHEAT RIVER, PA. AND W. VA.; TYGARTS RIVER, WEST FORK RIVER, KANAWHA RIVER AND ITS TRIBUTARIES, WEST VIRGINIA; MUSKINGUM RIVER AND ITS TRIBUTARIES, SCIOTO RIVER AND ITS TRIBUTARIES, MIAMI RIVER AND ITS TRIBUTARIES, OHIO; MAUMEE RIVER AND ITS TRIBUTARIES, OHIO AND INDIANA; WABASH RIVER AND ITS TRIBUTARIES, ILLINOIS AND INDIANA, WITH A VIEW TO DEVISING PLANS FOR FLOOD PROTECTION AND DETERMINING THE EXTENT TO WHICH THE UNITED STATES SHOULD COOPERATE WITH THE STATES AND OTHER COMMUNITIES AND INTERESTS IN CARRYING OUT SUCH PLANS, ITS SHARE BEING BASED UPON THE VALUE OF PROTECTION TO NAVIGATION.

DECEMBER 21, 1916.—Referred to the Committee on Flood Control and ordered to be printed, with illustrations.

WAR DEPARTMENT,
Washington, December 21, 1916.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith, a letter of this date from the Chief of Engineers, United States Army, submitting reports made by the Ohio Valley Flood Board on examinations of Cheat, Tygarts, West Fork, and Kanawha Rivers, dated August 31, 1916; Muskingum and Wabash Rivers, dated September 1, 1916; Scioto River, dated September 12, 1916; Miami River, dated October 30, 1916; and Maumee River, dated June 3, 1916, said examinations being authorized by the river and harbor act approved March 4, 1915.

The Chief of Engineers also calls attention to the fact that the report on Kankakee River has already been submitted to Congress, and is printed in House Document No. 931, Sixty-fourth Congress, first session.

He also quotes previous department correspondence on the subject of flood protection and prevention.

Very respectfully,

Newton D. Baker,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, December 21, 1916.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Flood protection and prevention.

1. The river and harbor act approved March 4, 1915, contained the following item:

> Cheat River in Pennsylvania and West Virginia; Tygarts River, West Fork River, Kanawha River and its tributaries, all in West Virginia; Muskingum River and its tributaries, Scioto River and its tributaries, Miami River and its tributaries, all in the State of Ohio; Maumee River and its tributaries, Ohio and Indiana; Kankakee River and the Wabash River and its tributaries, Illinois and Indiana, with a view to devising plans for flood protection and determining the extent to which the United States should cooperate with the States and other communities. and interests in carrying out such plans, its share being based upon the value of protection to navigation.

There are submitted herewith for transmission to Congress reports by the Ohio Valley Flood Board on examinations authorized by the above-quoted item of law relative to Cheat, Tygarts, West Fork, and Kanawha Rivers, dated August 31, 1916; Muskingum and Wabash Rivers, dated September 1, 1916; Scioto River, dated September 12, 1916; Miami River, dated October 30, 1916; and Maumee River, dated June 3, 1916. Report on the Kankakee River has already been submitted to Congress and is printed in House Document No. 931, Sixty-fourth Congress, first session.

2. All of these rivers are subject to floods, but the extent and character of the damage sustained vary greatly. The Cheat, Tygarts, West Fork, and Kanawha Rivers need no general protection against floods along their own length, and any work that might be done would be for the benefit of the main streams below. On the Muskingum, Scioto, Miami, Maumee, and Wabash Rivers the property damage caused by overflow of the river valleys has been large and considerable loss of life has resulted, especially along the Scioto and Miami Rivers. With these rivers the influence of floods upon the main waterways below is of far less importance than the effects along the streams themselves, and the communities bordering the streams are far more vitally concerned than the United States. The conservancy law of Ohio, passed February 6, 1914, authorizes the organization of drainage and conservation districts, "to prevent floods, to protect cities, villages, farms, and highways from inundation." Under this law a number of conservancy districts have been formed. In one of the Scioto districts alternative plans have been proposed, and in the Miami district a plan has been adopted by the conservancy court, under date of November 24, 1916, subsequent to the reports of the flood board and of the Board of Engineers for Rivers and Harbors.

3. The flood board finds in its consideration of these subjects that the determination of the benefits to navigation of flood protection is a difficult matter, and that while the United States might not be justified in the interests of navigation alone in cooperating with the States and other communities in devising or carrying out plans for flood protection on a stream considered by itself, the effect of each important tributary of the Ohio River upon the operation of the Ohio River dams and, resulting therefrom, on navigation, is such that the ordinary and flood flow of each should be determined, and that the question of preparation of plans for the control of the flow and the extent of cooperation which should be required should be fully investigated. Control over our waterways for purposes of flood prevention and protection must, in the opinion of that board, be delegated to one central authority, logically the Federal Government, before any rational plan for flood control can be devised and compliance with such plan or other measures for the amelioration of flood conditions properly enforced. The flood board emphasizes its opinion that such control should preferably not be based on the uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that will accrue in the protection of life and property from loss and in the prevention of the interruption by floods of general interstate commerce and the interference with the mails. The flood board believes that as a first step in proper flood protection the jurisdiction of the War Department should be extended to include nonnavigable streams, so as to give it supervision over all structures and constructions which may unduly interfere with interstate commerce. To secure the data necessary for the preparation of flood protection plans called for under the river and harbor act of 1915 and for the exercise of proper supervision, the board recommends surveys as indicated for each of the streams named in this report, and estimates the total cost of such surveys at $413,073.

4. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to this board's report herewith, dated November 21, 1916. The River and Harbor Board interprets the act of Congress authorizing this investigation as limiting the consideration of the subject to such action as can be justified by the interests of navigation alone. Under this limitation the board finds that the United States is not justified in cooperating with the States or other communities or interests in devising and carrying out plans for flood protection on these streams. The River and Habor Board does not recommend any general extension of Federal jurisdiction in nonnavigable streams. It believes, however, that on rivers similar to the Scioto and Miami, where local interests particularly are affected, a Federal interest may nevertheless exist and should not be entirely overlooked. The United States should therefore exercise some form of supervision, and it is believed that Federal approval should be required for all projects of flood control, which, in the opinion of the Chief of Engineers and the Secretary of War, are of sufficient magnitude to warrant such action. The River and Harbor Board believes that Federal activity in connection with the amelioration of flood conditions might, in the discretion of Congress, take the form of supervisory control, or the form of actual operations, in-

cluding in this expression, the preparation of plans. In some instances local interests may so predominate that the work should be left to State control. In such cases the plans should be submitted to the War Department for approval, and general legislation should give the War Department authority to extend its jurisdiction to the definite areas covered by such plans, if approved. In other instances, where great and widespread interests are involved and several States perhaps concerned, works of flood prevention might be deemed worthy of being undertaken by the United States with suitable cooperation of the communities affected. In such cases the legislation adopting the project should extend the jurisdiction of the War Department to the definite area covered by the plan. In the opinion of the board the estimates of the cost of surveys and the preparation of plans are too low in some instances.

5. Following the great flood of 1913 in the Ohio Valley a board of officers of the Corps of Engineers, United States Army, was appointed April 12, 1913, to report upon the most practicable and effective measures for prevention of damage by flood to works constructed for the improvement of navigation or interference with interstate commerce and other disastrous results thereof. The report of this board is published in House Document No. 914, Sixty-third Congress, second session. In forwarding this report to Congress the Secretary of War stated in part as follows:

> The subject of flood protection and flood prevention is one of great national import, and it is imperative that steps be taken to ameliorate conditions in the most afflicted districts in the various parts of the United States without unnecessary delay.
>
> The interests of navigation and of interstate commerce demand that the Federal Government seek a remedy and join with the local interests in applying it. Economical and efficient cooperation on the part of local interests is extremely difficult to attain unless the Federal Government lends its unifying and guiding power. By extension of the authority conveyed by sections 9 and 10, act of 1899, recommended above, the War Department would be empowered to pass upon plans evolved by various of the communities, with a view to insuring that they do not conflict with a general plan of flood protection for the entire district to the detriment of navigation and other interests; but it is my belief that the Federal Government should go further, and that to accomplish the best results it should undertake to prepare general plans of flood prevention and protection, to pass upon and coordinate plans prepared by the various communities, to arrange for a fair and proper distribution of the cost of execution of such plans, and the portion of the work to be accomplished by each of the interested parties. The portion of the expense of the undertaking which should be borne by the Federal Government should be the value of the protection rendered to navigation, to interstate commerce, and other Federal interests.
>
> If this work be placed under the War Department on the same basis as the river and harbor work, with which it is intimately connected, it can be accomplished with no large initial expense. No new and expensive organization need be created. Each case requiring appropriation will be presented in an intelligent, concise, and concrete manner for consideration by Congress, and with Congress will rest the decision as to which rivers shall be considered and the rate at which they shall be appropriated for.
>
> No new idea is involved in this arrangement; it is simply an extension of a plan that has operated successfully in several cases heretofore, notably in the California Débris Commission's project for the Sacramento and San Joaquin Valleys in California (H. Doc. No. 81, 62d Cong., 1st sess.). That project involves improvement of navigation, flood control, and the regulation of mining detritus, with irrigation and drainage problems also involved, at a cost originally estimated at $33,000,000, of which the United States was to contribute $11,000,000 as being the estimated value of the improvement to navigation.
>
> Hardly was this plan formulated when the local interests set to work on an enormous scale without awaiting appropriations from the United States or the

State, so that in February, 1913, the estimate of the cost of the work remaining to be done to complete the original plan was $11,717,000, of which the United States was to contribute one-half.

The same plan has been partially adopted in connection with the Mississippi River and can be readily extended with the help of the Mississippi River Commission to a complete solution of this great problem whenever Congress shall so decree.

I therefore wish to urge upon Congress the desirability of enacting the following legislation:

First. To extend the jurisdiction of the War Department to all feeders or tributaries of navigable waterways by the insertion of the following item in the pending river and harbor bill or by a separate bill:

SEC. —. That section ten of the river and harbor Act approved March third, eighteen hundred and ninety-nine, be amended by adding at the end thereof the following:

"And it shall not be lawful to place any obstruction in, along, or across any feeder or tributary of any navigable waterway of the United States which in the judgment of the Chief of Engineers and the Secretary of War will, in connection with floods or otherwise, injuriously affect the navigable capacity of said waterway or any structure built in aid of navigation, except as recommended by the Chief of Engineers and authorized by the Secretary of War."

Second. To authorize preliminary examination and survey in the pending river and harbor bill of the following streams, with a view to devising plans for flood protection and determining the extent to which the United States should cooperate with the States and other interests in carrying out such plans, its share being based upon the value of the protection to navigation and interstate commerce: Cheat River, Pa. and W. Va.; Tygarts River, W. Va.; West Fork River, W. Va.; Kanawha River and its tributaries, W. Va.; Muskingum River and its tributaries, Ohio; Scioto River and its tributaries, Ohio; Maumee River and its tributaries, Ohio and Ind.; and the Wabash River and its tributaries, Ill. and Ind.

The authorization of the examination and survey of the streams mentioned in this report was presumably an adoption by Congress of the second recommendation of the Secretary of War quoted above.

6. In this connection attention is invited to the decision of the Supreme Court of the United States in the case of the Rio Grande Dam (174 U. S., 690), in which it was held in effect that the jurisdiction of the War Department may be exercised, under the provisions of section 10 of the river and harbor act of March 3, 1899, to regulate structures placed in the nonnavigable portions of a stream or its tributaries when such structures may affect the navigable capacity of the stream below. From this is appears that no additional legislation looking to an extension of the jurisdiction of the War Department to feeders or tributaries of navigable streams is necessary for the protection of navigation.

7. On navigable streams it is apparent that the relation between channel conditions and the measures adopted for the control of floods is so direct and intimate that the Federal Government should exercise full and careful supervision over these measures and at least cooperate in their design. While this connection is evidently intimate in navigable waterways, it is not so clearly the case with the unnavigable affluents. There are cases, however, where this connection exists, and this is especially evident where storage reservoirs are designed for the double purpose of flood control and power development, which two uses of the same reservoir have in the past been found to be relatively incompatible. On nonnavigable streams, where the urgency of local flood problems leads to the formation of plans for flood relief without awaiting Federal assistance, it is obvious that the Federal Government should interpose no obstacle to the prosecution of such plans unless some important national interest

seems to be endangered thereby. This is especially true in cases such as that of the Miami conservancy district, where the plans have been prepared with so much care and are apparently beneficial rather than otherwise to any national interest involved.

8. After due consideration of the above reports, I conclude that, while it is not possible to state that the interests of navigation alone justify the expense of further investigation and the preparation of plans for flood control on the streams considered in this report, it is believed that the United States is justified in undertaking this work on account of the incidental benefits to navigation when taken in conjunction with the certain and positive benefits that will accrue to the general welfare of the country in the protection of life and property and the prevention of interruption by floods of general interstate commerce and interference with the mails.

9. I therefore recommend that the War Department be authorized to make surveys and prepare plans for flood protection on the Cheat River, in Pennsylvania and West Virginia; Tygarts River, West Fork River, Kanawha River and its tributaries, all in West Virginia; Muskingum River and its tributaries, Scioto River and its tributaries, Miami River and its tributaries, all in the State of Ohio; Maumee River and its tributaries, Ohio and Indiana; and the Wabash River and its tributaries, Illinois and Indiana; and, further, that the department be directed to determine the extent to which the United States should cooperate with the States and other communities and interests in carrying out such plans, taking into consideration the benefits that will accrue to all parties interested therein. In view of the difficulty of making accurate estimates from the data at hand, it is believed that the estimate of cost of these surveys should be increased to $500,000.

W. M. Black,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

War Department,
The Board of Engineers for Rivers and Harbors,
Washington, November 21, 1916.

From: The Board of Engineers for Rivers and Harbors.
To: The Chief of Engineers, United States Army.
Subject: Report on Flood Protection and Prevention.

1. The following is in review of the Ohio Valley Flood Board's reports authorized by the river and harbor act of March 4, 1915, on preliminary examination of—

> Cheat River in Pennsylvania and West Virginia; Tygarts River, West Fork River, Kanawha River and its tributaries, all in West Virginia; Muskingum River and its tributaries, Scioto River and its tributaries, Miami River and its tributaries, all in the State of Ohio; Maumee River and its tributaries, Ohio and Indiana; * * * Wabash River and its tributaries, Illinois and Indiana, with a view to devising plans for flood protection and determining the extent to which the United States should cooperate with the States and other communities and interests in carrying out such plans, its share being based upon the value of protection to navigation.

2. The flood board's reports are five in number covering, respectively, the following streams:

1. Cheat, Tygarts, West Fork, and Kanawha.
2. Muskingum and Wabash.
3. Scioto.
4. Miami.
5. Maumee.

The Board of Engineers for Rivers and Harbors will review all the above in one report, taking up the several streams in the order given in the item of law authorizing this investigation.

CHEAT RIVER.

3. Cheat River is one of the principal tributaries of the Monongahela, which it enters at the town of Point Marion. The drainage basin is a valley 102 miles long with an average width of 14 miles. The valley is rugged with steep slopes and swift streams lying in deep gorges. Sixty-nine per cent of the surface is covered by forests. The main stream, including Shavers Fork, is 157 miles long and the fall is 3,720 feet. The valley is in places very narrow and gorgelike with little bottom land. The principal tributaries, seven in number, range in length from 15 to 68 miles. The river is subject to rapid rises and quick run-off, and the alluvial bottoms have at times been flooded, notably in 1888. No definite estimate of the damage done is available, but it appears to have been inconsiderable and not of sufficient importance to justify preventive measures. There is no navigation present or prospective on the river.

TYGARTS RIVER.

4. Tygarts River unites with the West Fork to form the Monongahela. Its drainage basin is a valley about 70 miles long with an average width of 20 miles. The river has a total length of about 118 miles and a fall of 3,240 feet. About 43 per cent of the drainage basin is covered by forests. Its principal tributaries, five in number, range in length from 15½ miles to 61 miles. All have precipitous slopes. The stream is subject to sudden rises and quick run-off, and the alluvial bottoms have sometimes been flooded, notably in 1888, with more or less damage, the exact amount of which has not been determined. It is stated, however, that the damage sustained has not been enough to justify prevention works of a general character. There is no navigation, present or prospective, on this river.

WEST FORK RIVER.

5. West Fork River joins the Tygarts River to form the Monongahela. Its drainage basin is a valley about 62 miles long with an average width of 14 miles. About 15 per cent of the drainage area is covered by forests. The river is about 94 miles in length and its fall is 750 feet. Most of the bottom land is under cultivation. The principal tributaries are Tenmile Creek, 21 miles long, and Elk Creek, 26 miles long. The stream is subject to sudden rises and quick run-off, and some damage has been done to towns, coal

mines, crops, and bridges, particularly by the flood of 1888, but no definite estimate of loss appears to be available. There is no navigation, present or prospective, on the river.

6. The flood board discusses the local effect of floods in these three streams and their ultimate effects on the Monongahela and upper Ohio Rivers. It states that nothing is known of any local conditions which intensified the flood of 1888 on the West Fork, Tygarts, or Cheat River; that much of the damage was confined to small tributaries, and no system of flood protection, except very local treatment, would prevent occasional damage on these small streams; that reservoirs will probably never be justified for local use alone, but might possibly be built for more general purposes and incidentally improve local conditions. The effect of high waters from these streams on the upper Ohio is shown in a table of gauge heights, from which it will be seen that the West Fork is responsible for an increase in stage at Davis Island, about 4 miles below Pittsburgh, of 0.4 to 1.3 feet; the Tygarts, 0.8 to 2.3 feet; and the Cheat, 0.6 to 3.5 feet. This effect, of course, decreases farther downstream.

7. As local protection on these streams does not appear justifiable and any work that might be undertaken would be for the benefit of the main streams below, the method of improvement to be followed becomes one of storage reservoirs; and the flood board states that if reservoirs are not deemed feasible nothing should be done. There appear to be several good sites for reservoirs on each of these rivers, and from an engineering standpoint their construction is feasible. Their effect on the rivers below, if used solely for the protection against floods, would be beneficial, but their cost would be relatively high. The construction of reservoirs on the Cheat River for power development is contemplated by private capital. Reservoirs for the combined use of power and flood control are not generally practicable, as these purposes are in a measure antagonistic. It is possible, however, at increased cost to store water for both purposes, and the flood board believes the subject worthy of further study and investigation. It does not seem probable that there will be a demand for power development on either the West Fork or the Tygarts.

KANAWHA RIVER.

8. The Kanawha River is a tributary of the Ohio, which it enters at Point Pleasant, 265 miles below Pittsburgh. It is formed by the junction of the New and Gauley Rivers, 97 miles above its mouth. The total drainage area is about 12,000 square miles. At Kanawha Falls, 94 miles above its mouth, the fall is about 30 feet. From the Falls to the mouth it is about 110 feet. New River is the principal tributary and should be considered as a part of the main stream. In the 90 miles above the Falls the river drops about 825 feet. The valleys are nowhere wide, and the extent of bottom land is very limited. Sudden freshets are frequent and the run-off is rapid. The lower portion of the river is subject to inundation by backwater from the Ohio.

9. The river has been improved at Federal expense by the construction of 10 locks and dams, which afford a 6-foot navigation for about 88 miles above the mouth. There has been expended on the

river approximately $4,298,000 for improvement and $1,571,000 for care and operation. In recent years the annual commerce has ranged from about 1,100,000 tons to 1,400,000 tons.

10. The record concerning floods on the Kanawha is meager. It is known that buildings, coal tipples, railroads, and farming lands have been damaged from time to time, but apparently the loss has not been great. On some of the tributaries the loss of both life and property has upon several occasions been considerable. Injury to works of navigation has been small, and there is no apparent demand or necessity for flood protection in the interests of navigation. The principal benefit from such protection would therefore be felt through its effect upon the Ohio River at and below Point Pleasant. The method to be employed would apparently be the construction of storage reservoirs. There are a number of sites available for such structures.

MUSKINGUM RIVER.

11. The Muskingum River lies wholly within the State of Ohio and empties into the Ohio River at Marietta. Its watershed is approximately 7,800 square miles and its extreme length 225 miles. The river was improved by the State of Ohio between 1837 and 1841 by the construction of 11 dams, 12 locks, and 5 short lengths of canal, at a cost of approximately $1,500,000, creating 91 miles of slack water from the mouth to Dresden, with a navigable depth of 6 feet. These improvements were taken over by the United States in 1887, since which time they have been repaired and maintained at a cost of approximately $2,000,000. The annual commerce during the past three years has varied from about 66,000 tons to 61,000 tons.

12. Above Zanesville the river valleys are shallow and broad, with comparatively wide flood plains. At Zanesville the river passes through a rocky gorge with abrupt hills on either side, so that flood waters from above are concentrated at this point. Below Zanesville the valley continues to be narrow, with steep bluffs.

13. The greatest flood of record was the result of the storm of March, 1913, when the water reached a height of 51.8 feet on the Zanesville gauge, 15 feet higher than ever before. The estimated maximum flow at Zanesville was about 300,000 second-feet and at the mouth of the river 325,000 second-feet. Great damage resulted from this flood, the direct loss being placed at $8,990,000, of which $3,165,000 was at Zanesville, the remainder being distributed throughout the watershed. The damage to the works of river improvement is estimated at $112,000, or 1.3 per cent of the total. Local obstructions to the high-water flow, such as bridges, buildings, etc., intensified the damage at certain localities. Eighteen bridges were destroyed on the Muskingum alone. No previous losses approach these figures.

14. The flood board concludes that for Ohio River floods a reduction in height of at least 1 foot at Marietta for each 3-foot reduction at Zanesville could be expected at stages above the danger stage, and that if the stage at Zanesville had not exceeded 34 feet the maximum stage at Marietta would have been about 52 feet, or some 6 feet less than the actual.

15. The characteristics of the stream valleys do not permit the general use of levees for flood prevention, and the flood board believes that retarding reservoirs with perhaps controllable outlets would probably offer the best results. It gives a table of possible sites for such structures, with their height, length, capacity, drainage area, and approximate flooded area. These reservoirs would store approximately 57,000,000,000 feet and lower the flood crest at Zanesville from 51.8 feet to about 41.5 feet, and the discharge from 300,000 second-feet to about 159,000 second-feet. If it be assumed that the flood waters from the Licking River pass Zanesville before those from the drainage basins above reach that point these figures become about 39 feet and 147,000 second-feet, respectively. The controlled flood of 1913 would have resulted in a gauge height and discharge slightly greater than those attained during the flood of 1898, the next highest of record. Whether any greater reduction is practicable through combined methods of restrictive works can be determined only after further study based on careful surveys.

SCIOTO RIVER.

16. The Scioto River with its tributaries forms the chief drainage system of central Ohio, covering an area about 50 miles wide and 135 miles long. The river is a tributary of the Ohio, which it enters at the city of Portsmouth. About midway of the drainage area is the city of Columbus, having a population of about 181,500. There is no navigation except a local movement of sand and gravel at Columbus. No works of improvement have been undertaken by the United States.

17. The drainage system is naturally divided into three sections, each with distinct characteristics. The upper or summit section is the imperfectly drained flat divide between the waters of the Ohio River and those of Lake Erie. A large part of the swampy land of this section has been drained and made available for agriculture, but much of it is subject to periodical overflow. In the flood of 1913 some 49,000 acres of rich farming land were submerged to depths up to 10 feet. The like happened in 1915, with greater loss than ever before. The flood board estimates the damage from the 1915 storm to the farming community at about $750,000. Damage to the towns in the summit section has not been large. The middle or gorge section extends for about 40 miles between Greencamp and Columbus. The river here flows through a narrow valley having practically no flood plain. and but little damage has been done to agricultural lands. On the Olentangy River, which joins the Scioto at Columbus, many bridges were carried away and 19 lives were lost in the flood of 1913. The alluvial section extends from Columbus to the mouth of the river, a distance of about 100 miles. The drainage area above Columbus is 1,614 square miles. The flood discharge at Columbus in 1913 was about 140,000 second-feet, of which 80,000 came from the upper Scioto, and 60,000 from the Olentangy. The slope of the stream in this section is about 2 feet per mile. The banks vary in height from 15 to 25 feet, the width between banks from 200 feet to 350 feet, and the flood plain from about 3,000 feet at the narrowest point to 3½ miles. The agricultural lands have been partially protected by local levees, but these were entirely inadequate

to withstand the flood of 1913. The estimated damage to agricultural lands is $944,500, in addition to which depreciation of values is placed at $20 per acre, or about $1,423,340. The estimated damage to crops in 1915 is $500,000. The loss at Columbus is placed at $5,291,000, and 93 lives, and the loss at Chillicothe at $1,000,000, and 19 lives.

18. As a result of the 1913 flood the city of Columbus obtained engineering advice as to the remedies to be adopted to secure immunity from similar floods. A plan involving a cut-off within the city limits combined with levee construction, at a total estimated cost of $11,000,000 was recommended. Prof. Sherman, of the Ohio State University, prepared a study of the flood problem in the Scioto Valley contemplating reservoirs at the headwaters, a connection between the Scioto and the Sandusky Rivers, and the combined uses of power, water supply, navigation, and flood protection, cost not given. Another study for the complete control of the problem was prepared and recommended after the flood of 1915 by the engineers who had submitted the first plan mentioned. This second plan contemplates two retarding reservoirs, one on the Scioto and one on the Olentangy, and certain channel improvements, at a total estimated cost of $10,000,000.

MIAMI RIVER.

19. The Miami River rises in the southern portions of Auglaize and Hardin Counties, Ohio, and empties into the Ohio about 20 miles below Cincinnati on the dividing line between the States of Indiana and Ohio. Its drainage area in the State of Ohio is about 4,000 square miles. Its length from its headwaters to the mouth is about 163 miles. The two principal tributaries in Ohio are the Stillwater and Mad Rivers, which unite with the Miami at Dayton, about 60 miles above the mouth.

20. No works of improvement on the Miami for the benefit of navigation have ever been undertaken by the United States. There is no commercial navigation on the river at the present time and none is practicable without extensive improvement involving the use of locks and dams.

21. The flood stage at Dayton is considered to be 18 feet on the local gage. This stage has been exceeded but four times in the past 50 years, 1866, 1883, 1889, and 1913. A stage of 29 feet was reached in 1913, which was 7.7 feet above the highest recorded up to that time. The channel capacity at Dayton is about 100,000 second-feet. During the 1913 flood the flow reached a maximum of 250,000 second-feet. The union of the Miami and its two principal tributaries at Dayton causes rapid accumulation and high stages at this city.

22. The average channel capacity of the Miami River above Dayton as determined at five localities is given as 8,000 second-feet, and the corresponding discharge in the 1913 flood as 81,440 second-feet. The area flooded above Dayton was 17,400 acres. In the upper valley are the cities of Piqua, with a population of 13,388, and Troy, with a population of 6,122. The flood of 1913 inundated about 22 per cent of the former and 50 per cent of the latter, resulting in much loss of life and property.

23. At Dayton 44 per cent of the area of the city, including the business section, was submerged to depths up to 10 feet. The prop-

erty loss at Dayton has been estimated at more than $46,000,000, and 73 lives were lost. The town is protected from ordinary floods by levees, but these proved inadequate during the flood of 1913.

24. In the lower valley are a number of towns, of which the principal are Miamisburg, population 4,271; Franklin, population 2,659; Middletown, population 13,152; and Hamilton, population 35,279, all according to the census of 1910. All of these were more or less inundated and suffered large loss of life and property. The total loss in the entire valley is estimated at over $66,000,000 and 361 lives, as given in detail in the report under review.

25. The Miami conservancy district was formed under authority of the Ohio conservancy act of February 6, 1914, for the purpose of extending flood protection to the Miami Valley. Much study has been given to the problem and a plan prepared which provides for five retarding reservoirs in the upper river and on its principal tributaries; raising, strengthening, and protecting levees where necessary; deepening and straightening channels at stated places; and protecting the banks by revetments. The estimated maximum total cost of the project is $23,539,872. While this plan does not completely protect the entire valley, it aims to provide protection to all places where protection is urgently needed. The flood board states that by increasing the scope of the plan the benefits might be made more general in character. Such increase in scope would involve greater expense and would have to be justified by additional benefits.

MAUMEE RIVER.

26. The Maumee River, 125 miles in length, is formed by the junction of the St. Marys and the St. Joseph Rivers at Fort Wayne, Ind., and empties into Lake Erie about 4½ miles below the city of Toledo. The principal tributaries are the Tiffin and the Auglaize Rivers. The total drainage area of the Maumee River system is 6,724 square miles. The river has a winding course through the bottom lands between the valley banks. Floods seldom overtop the valley banks, but often flood the bottom lands. Ice gorges cause frequent local floods, particularly on the lower river. As the valley is narrow, the flooded area is small.

27. The flow through the valley when the river overtops its banks is obstructed by farm buildings, parts of towns extending into the lowlands, bridges and their approaches, and the filling in of bottom lands. All these things tend to reduce the flood channel and correspondingly raise the flood height. Some bridges have been destroyed, but little damage has been done to the buildings, and, as far as known, there has been no loss of life. Farm lands have been overflowed, destroying crops from time to time, but these losses are largely compensated for by increased fertility of the soil.

28. Works of improvement on this stream by the United States have been confined to the channel below Toledo, where a depth of 23 feet has been provided. On the upper portion some levees have been constructed for local protection. There is no commercial navigation on the river above Toledo. Short stretches of the river form a part of the Miami and Erie Canal, which follows the stream closely from Toledo to Defiance.

29. Reliable data as to floods are lacking prior to 1913, when the greatest flood heights on record were reached, except those resulting from ice gorges on the lower river. Actual damage prior to 1913 appears to have been small. The greater amount of damage from the 1913 flood is reported by the flood board as having been caused by the encroachments on the flood channel referred to above. The estimated money loss from this flood is placed at $2,096,000, and for floods prior to 1913 at $211,000, the records of the latter being very incomplete. The estimate for Fort Wayne is placed at $1,000,000. This appears to be large, as but one house was carried from its foundation, the main damage being due to the wetting of property. Other towns damaged were Defiance, Ohio, to the extent of $450,000; Napoleon, Ohio, $15,000; Oakwood, Ohio, $92,000; Ottawa, Ohio, $200,000; and Lima, Ohio, $235,000.

30. The flood board states that the evidence shows clearly that the flood damage in the towns affected was very much increased by obstructions placed in the flood channels, and these conditions can be greatly ameliorated by means of local channel improvements. A natural high water channel from a point on the St. Marys River, a few miles above Fort Wayne, enters the Maumee River a few miles below that city and carries a part of the flood waters. Among the remedies suggested are enlargement of the diversion channel just referred to; increasing the discharge section of the river; removing artificial and other obstructions; raising levees; increasing bridge openings; substituting open structures for railroad embankments; cutting off projecting points and widening the river; constructing retarding reservoirs.

31. The greatest damage along this river was done at Fort Wayne where the original flood channel has been materially encroached upon by artificial obstructions. It is estimated that protection of this locality from a similar flood by the use of retarding reservoirs which would lower the flood height 4 feet would cost about $2,900,000; and that similar protection by storage reservoirs would cost $5,800,000. To meet a possible combination of flood conditions, these estimates might have to be increased to $6,625,000 and $13,200,000, respectively. Practically the only benefit from these reservoirs would be to the immediate vicinity of Fort Wayne. Two plans of improvement have been considered by the city of Fort Wayne. One provides for opening up and maintaining the original channels to full flood capacity at an estimated cost of $1,524,000, the other for a partial restoration of the original channels supplemented by a cut-off, at an estimated cost of $1,226,000. The latter plan has been adopted. Either of these methods would be far more economical than reservoirs. Definite information regarding flood heights and discharge on the Tiffin and Auglaize Rivers is lacking. It appears, however, that a general plan of protection by means of reservoirs would cost more for the Auglaize system than for the St. Marys and St. Joseph Rivers combined.

32. The only serious effect of floods upon navigation is the deposit of sediment in the navigable channel at and below Toledo. Reservoirs might result in reducing the turbidity of the flood waters and consequently the amount of sediment brought down by the river. They would, however, reduce the rate of flood discharge and prolong its duration, thus lessening its scouring effect and increasing the time

of sedimentation. Based upon the general information available, the flood board believes that the method of local channel improvement is the best for the upper Maumee, the St. Marys and St. Joseph Rivers, and probably best for the remainder of the system, with the possibility of retarding reservoirs for local improvement in the headwaters of the Auglaize.

WABASH RIVER.

33. The Wabash River drains portions of Ohio, Indiana, and Illinois. The total drainage area is 33,000 square miles. The length of the river is about 517 miles and the fall 685 feet. The river has been improved by the United States by the construction of a lock and dam at Grand Rapids and by open-river methods at a total expenditure of approximately $810,000 for improvement and $82,000 for operation and care of lock. There is practically no general commercial navigation on the river.

34. No general project for flood control has been adopted on this river, but many attempts have been made by private interests to protect individual communities, principally by the construction of levees. These are generally effective during ordinary floods, but not during great floods. Many of these levees are improperly placed, causing undue restriction of the flood section and consequent loss to private owners or communities. Since 1847 there have been 11 serious floods recorded and many minor ones, and almost every year the river overflows its banks.

35. The greatest flood recorded is that of March and April, 1913, which resulted in damages in Indiana alone estimated at $25,000,000. The capacity of the stream is being constantly reduced by encroachments on the channel by improperly located levees, by the construction of bridge approaches, by city dumps, etc. A study of the physical conditions along this river indicates that the method of flood protection best adapted to the locality is that of levees, channel improvements, and the removal of obstructions from the flood plain. The flood board states that the entire river below Terre Haute might perhaps be completely leveed, and this work might be combined with channel enlargement, etc. The Rivers and Lakes Commision of the State of Illinois offers cooperation in the collection of data bearing upon the questions involved, and the flood board states that similar cooperation may be expected from the State of Indiana.

GENERAL RECOMMENDATIONS OF THE FLOOD BOARD.

36. The flood board finds in its consideration of these subjects that the determination of the benefits to navigation of flood protection is a difficult matter, and it concludes that the United States would not be warranted in the interest of navigation alone at this time in cooperating with the States and other communities and interests in devising or carrying out plans for flood protection on any one of these rivers if other rivers are not also to be considered. Each of these streams, however, is regarded as important as a part of any general scheme of flood control. The flood board believes that the flood problem is an important one, deserving the consideration of the Federal Government to a greater extent than is now possible under the limitations of the law which recognizes only the interests

of navigation. It believes that jurisdiction over the waterways for purposes of flood control, as well as for navigation, should be delegated to one central authority which is logically the Federal Government, and it recommends that the authority of the War Department be extended to include nonnavigable streams, so as to give it supervision over all structures and constructions which may unduly interfere with stream flow and increase flood heights, flood damages, and interfere with interstate commerce.

37. The flood board recommends further surveys and investigations to determine the effects upon navigation of floods on these streams and for a more definite solution of the flood problems. It estimates the cost of the necessary surveys and the preparation of complete plans for flood control with accurate estimates of cost, as follows:

Cheat	$8,052	Miami	$18,000
Tygarts	5,038	Maumee	73,500
West Fork	5,483	Wabash	200,000
Kanawha	45,000		
Muskingum	40,000	Total	413,073
Scioto	18,000		

COMMENTS AND CONCLUSIONS OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

38. The information submitted does not indicate that navigation has any substantial interest in these works of flood control and the Board of Engineers for Rivers and Harbors concurs with the flood board in its conclusion that the United States is not justified in the interests of navigation alone in cooperating with the States or other communities or interests in devising and carrying out plans for flood protection on these streams.

39. It is apparent from the report of the flood board that the Cheat, West Fork, Tygarts, and Kanawha Rivers do not present flood problems of such magnitude as to warrant extensive works for the protection of interests along their banks. The justification for such works must be found, if anywhere, in other localities bordering on the rivers to which these streams are tributary.

40. With the Muskingum, Scioto, Miami, Maumee, and Wabash the case is different. The damage done by the flood of 1913 in the valleys of these rivers is estimated at more than $100,000,000. What happens below the mouths of the streams becomes in these instances of far less relative importance than the effects along the streams themselves, and works for local protection are amply justified.

41. In such cases very large expenditures may be required. As an example of such a project, there may be mentioned the proposed operations of the conservancy district embracing Dayton, Ohio, upon the Miami River. This district, consisting of nine counties, has been formed and is proceeding in accordance with a recent Ohio statute. For studies and the preparation of plans and estimates, including the proper presentation to the State legislature of the necessity for the law above referred to, before it was enacted, there has been expended about $750,000. Those who prepared the plan have stated that, if no general studies and preliminary work of an educational nature had been required, $250,000 would have sufficed for the preparation of proper plans and estimates. The work to be done consists for the most part in the construction of a number of retarding reservoirs, to

hold back and distribute over an increased period of time the run-off during floods from certain areas above. The execution of the project will, it is estimated, cost about $23,000,000. If the project is finally adopted in accordance with State law, the property to be benefited will be assessed in proportion to the benefits expected in each case, and will bear the entire cost. The project is still under advisement, and is meeting with opposition from those, among others, who prefer another plan based largely upon channel enlargement within and below the area to be benefited.

42. The Federal interest in the project as at present formulated is relatively of slight extent, and is almost wholly limited to preventing interruptions of interstate commerce and of the mails, which might be expected to occur within the conservancy district, under present conditions, during periods of great local rainfall. The Federal benefits would be but a minute fraction of the aggregate benefits to all interests. The effect upon the Ohio, of which the Miami is a tributary, would be to lessen the flow into the Ohio during what would have been the crest of a Miami flood, and to increase the flow for a few days thereafter. If the project had been formulated as proposed by those who prefer enlarged channels to retarding reservoirs, the effect of the work would be to expedite the flow of a Miami flood into the Ohio, and to increase the flow into the Ohio at the crest of such a flood. In whichever way a Miami flood were controlled sometimes the effect upon flood conditions in the Ohio would be beneficial and sometimes the reverse, depending upon when the crest of an Ohio flood might pass the mouth of the Miami, although the control by means of retarding reservoirs would probably more often improve Ohio River flood conditions, while certainly promising better average conditions along the Miami below the conservancy district. However the Miami might be regulated, the net result of this work during a period of years would be very small in the Ohio when compared with the benefits experienced within the Miami conservancy district.

43. Conservancy districts have been established elsewhere in the State of Ohio, but less progress has been made than in the Miami.

44. In these instances, and without doubt in others, the communities bordering on the streams are far more vitally concerned than the United States, and their interests should have corresponding weight. Nevertheless, in such cases a Federal interest may exist and should not be entirely overlooked. In two of the conservancy districts, that of the Miami and one of the Scioto, alternative plans have been proposed, one contemplating reservoirs, in order to hold the water back, and one providing for channel improvement, in order to speed it along. The like alternative will probably present itself elsewhere in the Ohio Basin, and the difference in the effect upon the Ohio River might in the aggregate be considerable. The United States should therefore exercise some form of supervision, and it is believed that Federal approval should be required for all projects of flood control which, in the opinion of the Chief of Engineers and the Secretary of War, are of sufficient magnitude to warrant such action.

45. The board is unable, however, to concur with the Ohio River Flood Board in its recommendation that the jurisdiction of the United States be extended to "all structures and constructions here-

after placed on nonnavigable streams which may unduly interfere with stream flow and increase flood heights." This would mean that plans for all bridges, embankments, etc., no matter where located, would have to be submitted for approval to some officer of the United States. The expense entailed upon the United States by such a policy and the inconvenience to local communities would be great, and most of the cases presented would probably be of no real importance. Also it seems evident to the board that in the absence of approved plans to work to, the control proposed could not be adequately exercised.

46. Federal activity in connection with the amelioration of flood conditions might, in the discretion of Congress, take the form of supervisory control or of actual operations, including in this expression the preparation of plans. In some instances local interests may so predominate that the work should be left to State control. In such cases the plans should be submitted to the War Department for approval, and general legislation should give the War Department authority to extend its jurisdiction to the definite areas covered by such plans, if approved. In other instances, where great and widespread interests are involved and several States perhaps concerned, works of flood prevention might be deemed worthy of being undertaken by the United States with suitable cooperation of the communities affected. In such cases the legislation adopting the project should extend the jurisdiction of the War Department to the definite area covered by the plan.

47. It appears from the report of the flood board that the preparation of complete plans for the streams discussed in this report will involve considerable expense, the total estimate being $413,073. The Board of Engineers for Rivers and Harbors believes that the estimates of the flood board are too low in some instances. This, however, is a matter of detail that is not necessary to determine at this time. It is understood that Congress desires information of a more general character sufficient in scope for the basis of a policy regarding flood matters, and it is believed that the reports as presented fulfill this requirement. No further action by the department is therefore recommended at the present time.

For the board:

Fredreric V. Abbot,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF CHEAT, TYGARTS, WEST FORK, AND KANAWHA RIVERS, PA. AND W. VA.

War Department,
Office of the Division Engineer,
Central Division,
Cincinnati, Ohio, August 31, 1916.

From: The Ohio Valley Flood Board.
To: The Chief of Engineers, United States Army.
Subject: Report on preliminary examination of West Fork, Tygarts, Cheat, and Kanawha Rivers.

1. Pursuant to instructions contained in E. D. letter of December 14, 1915, the board of officers of the Corps of Engineers (constituted

by S. O., No. 3, O. C. of E., 1913, as amended by subsequent orders) submits the following report on the preliminary examination of West Fork River, W. Va.; Tygarts River, W. Va.; Cheat River, Pa. and W. Va.; and Kanawha River, W. Va.

2. This report is based upon information furnished the board by the district engineer officers at Pittsburgh, Pa., and Wheeling, W. Va., to whom the duty of making the preliminary examination was assigned by E. D. letter of April 16, 1915.

3. These examinations were authorized by the following item in the river and harbor act approved March 4, 1915:

> SEC. 15. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, and a sufficient sum to pay the cost thereof, as well as those included in section fourteen may be allotted from the amount provided in this act: *Provided*, That allotments of such amounts as may be necessary may be made toward the completion of examinations and surveys heretofore authorized and for such other contingent expenses as are usually paid from the appropriation for "Examinations, surveys, and contingencies," to wit:
>
> * * * * * * *
>
> Cheat River in Pennsylvania and West Virginia; Tygarts River, West Fork River, Kanawha River and its tributaries, all in West Virginia; * * * with a view to devising plans for flood protection and determining the extent to which the United States should cooperate with the States and other communities and interests in carrying out such plans, its share being based upon the value of protection to navigation.

WEST FORK RIVER.

4. The West Fork River is one of the chief tributaries of the Monongahela. The drainage basin is a valley 62 miles long, with an average width of 14 miles. Its area is 875 square miles. It includes Harrison County and portions of Marion, Taylor, Barbour, Lewis, and Upshur Counties, W. Va. The general character of the valley is hilly and rugged. Fifteen per cent of the surface is covered by forest.

5. The West Fork River rises in the western part of Upshur County, W. Va., and flows northwestward into Lewis County, and thence in a slightly northeasterly direction to its junction with the Tygarts River, with which it forms the Monongahela River 1¼ miles above Fairmont. Its length is 94 miles and its total fall 750 feet. Beginning at its source, where the hills attain an altitude of 1,600 feet above sea level, the stream has an average fall of 75 feet a mile for 7 miles and 4.5 feet a mile for 20 miles to Weston, W. Va. For this distance of 27 miles the river lies in a gorge with high and steep sides. The next 36 miles, to Clarksburg, W. Va., have an average fall of 2.1 feet per mile. In this stretch the hills on either side are widely separated and broad areas of bottom land are found along the main valley and along one of the tributaries, Hackers Creek. Most of the bottom land is under cultivation. The river is quite winding, with sharp bends at many places. At Clarksburg, Elk Creek, one of the chief tributaries, enters from the right bank. From this point to the mouth, a distance of 31 miles, the slope of 2.1 feet per mile continues. The lower valley is much narrower than it is above Clarksburg, and many of the hills rise to a height of 400 to 500 feet above the river. There is a little bottom land here and there along the banks, but its total area is quite limited. Most of it is under cultivation.

6. The tributaries which are worth noticing are the following:

Name.	Length.	Average fall per mile.
	Miles.	*Feet.*
Ten Mile Creek, W. Va	21	15
Elk Creek	26	16

7. Rainfall observations have been taken at the following places:

Station.	Period of record.	Full years of record.	Mean rainfall.
			Inches.
Weston	[1] 1889–1911	23	47.95
Fairmont	[1] 1892–1913	22	42.77
Lost Creek	[1] 1896–1913	18	43.68

[1] Inclusive.

The mean for these three stations, 44.80 inches, is assumed to be the mean annual rainfall for the West Fork Basin.

8. Gauge readings have been taken, partly by the United States Geological Survey, partly by the Pittsburgh Flood Commission, and partly by the United States Weather Bureau, at the following places:

Enterprise	1907 to date.
Weston	1884 to 1909.
Butchersville, 3 miles below Weston	1915 to date.
Elk Creek, just above Clarksburg	1910 to date.
Fairmont (Monongahela River)	1904 to date.

All of these gauges have been read twice daily, with the exception of the one at Weston. This one was read once daily. Since 1914 the work has been carried on by the United States Geological Survey in collaboration with the Pittsburgh engineer office.

9. Discharge measurements sufficient for a rating curve are available at Enterprise, on the West Fork. Flow at other points has been computed on the assumption that run-off is proportional to area drained.

10. Geological Survey maps are available for the entire basin, which is shown on portions of five of the rectangular sheets 13½ inches by 17½ inches; but these sheets are not all on the same scale. The scale of one of them is 1:125,000; the other four 1:62,500. They also differ in other particulars. One of them has contours at vertical intervals of 100 feet and the other four at intervals of 20 feet. These contours are quite sufficient to show the general character of the country. Besides these maps there are the post-route maps of Pennsylvania and West Virginia, which, so far as they go, agree with the Geological Survey maps, but are not contoured. The map accompanying this report was traced from the post-route maps and is intended to show only the outline of the basin and the stations where measurements of rainfall and stream flow have been made.

11. No previous examination has been made with flood protection in view. One examination has been made with a view of determining the worthiness of the river for improvement as a navigable stream.

This report is to be found in House Document No. 88, Fifty-sixth Congress, first session. It recommends that the river is not worthy of improvement. There is no navigation on the West Fork River, nor does any seem likely.

12. From the characteristics of the basin it naturally follows that the West Fork River is subject to sudden rises. By reason of the steepness of the hills and the considerable slopes of the tributaries water quickly accumulates after a rain, but owing to the moderate slope of the main stream below Weston it is unable to run away as quickly, and high stages below this place are inevitable. The alluvial bottoms have been not infrequently overflowed, and damage has been done to towns, railroads, coal mines and bridges, especially during the flood of 1888, which is the highest on record.

13. This flood of 1888 occurred in the month of July, reaching its maximum in this river and other tributaries of the Monongahela on the 10th of that month. The rainfall during June was not excessive, and the rivers in the Monongahela Basin were at a low stage. The cause of the flood appears to have been concentrated rainfall on July 9 and 10. At Buckhannon, W. Va. (in the Tygarts River Basin) 3.25 inches fell on July 9 and 3.90 inches on July 10. The readings of the lower gauge at Lock No. 4, Monongahela River, at this time were as follows:

July 8	6.9
July 9	26.0
July 10	42.0
July 11	27.0
July 12	14.5

This gauge reads 6.9 feet at ordinary low water and 6.2 feet when the water is even with the top of the dam. The flood began at a time of low water, and a few days after it had passed the water in the Monongahela and its tributaries was as low as before. The rain came from the southwest, and apparently was not heavy north of the Ohio. The precipitation in the Allegheny Basin was light. This flood caused suspension of traffic on the Monongahela River for about two days, flooded the United States boat yard at Charleroi, but did no great damage there, and wet the lower stories of most of the lock houses. On the Ohio River no noticeable damage was done. At Pittsburgh the river slightly exceeded the critical stage (22 feet on the point gauge), anything above which is deemed a flood.

14. No accurate figures are available for flood injury to farm lands in the West Fork Valley, but a newspaper article, published immediately after the flood of 1888, states that crops were severely damaged and estimated the total damage in the entire county of Harrison amounted to $300,000. It seems likely that the damage to crops was due more to heavy rainfall and the wind than to floods. The chief towns along the West Fork and the damage which they suffered in this flood are as follows:

Weston, W. Va. (population, 2,000): The only time there was any damage from floods was on this occasion, when about 40 houses were affected by backwater. Through traffic on the railroad was interrupted for more than a week.

Clarksburg, Harrison County (population, 11,500): Located at the junction of Elk Creek and West Fork River, on the B. & O. Railroad. Practically no injury has been caused by floods with the exception of this one, which wrecked 25 houses along Elk Creek and affected 25 others by backwater. Seven bridges were destroyed, valued at $8,000 each. On the river 60 houses were slightly

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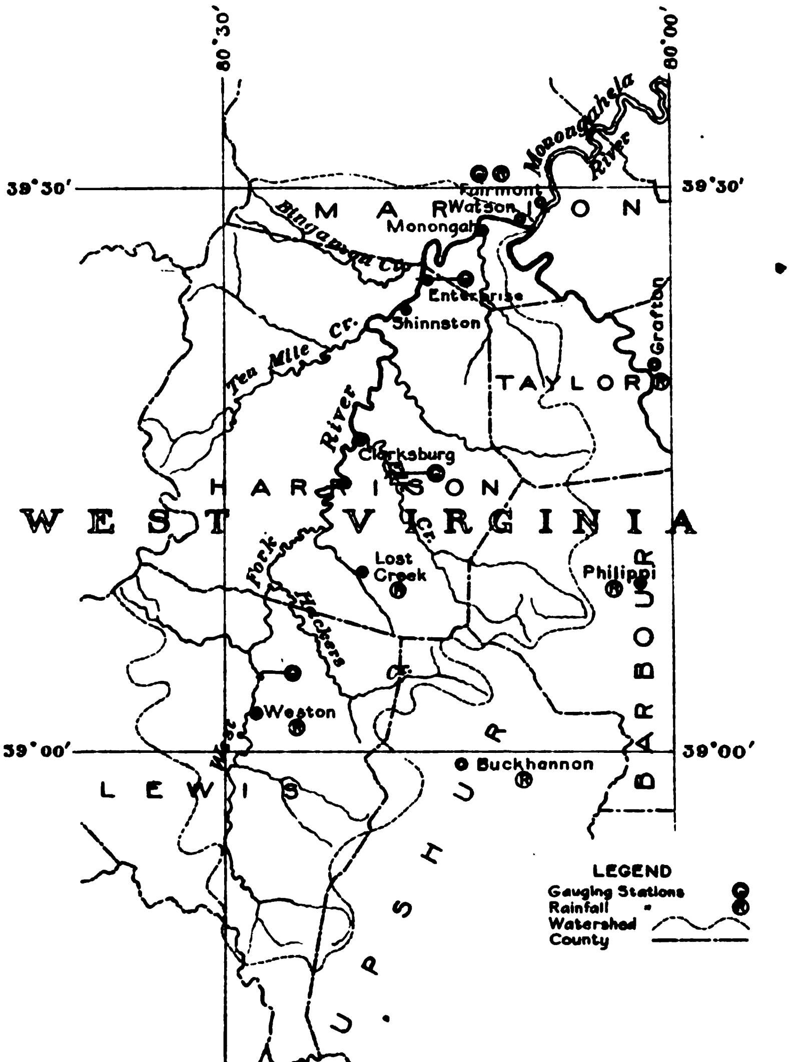


WEST FORK RIVER

DRAINAGE AREA 875 SQ. MI.

Prepared under the direction of
Lt. Col. Francis R. Shunk
Corps of Engineers, U. S. A.

A. B. McGrew, Asst. Engineer.

Scale Miles
0 1 2 3 4 5 10

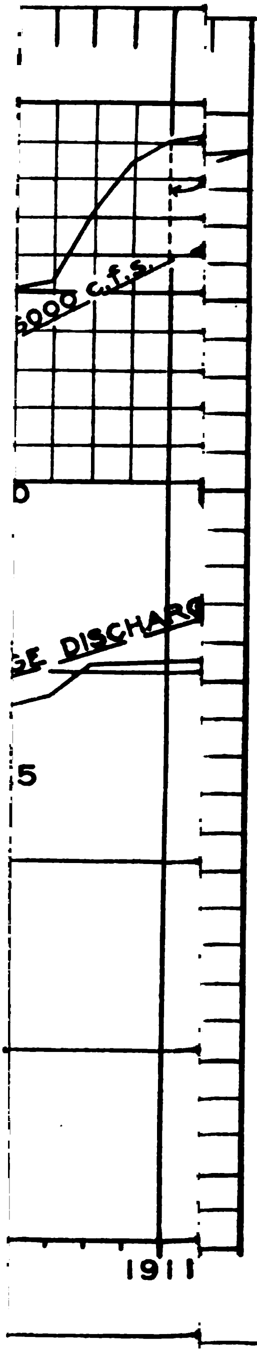
U. S. Engineer Office
Pittsburgh, Pa., Dec. 23, 1915.

Approved: Francis R. Shunk
Lt. Col. Corps of Engineers, U.S.A.

Drawn by W. F. S. Dec. 18, 1915.
Traced by W. F. S. Dec. 18, 1915.
Checked by E. F. A. Dec. 22, 1915.

THE NORRIS PETERS CO., WASHINGTON, D. C.

House Doc. No. 1792 : 64th Cong., 2d Sess.



CORPS OF ENGINEERS, U.S. ARMY

WEST FORK RIVER
MONONGAH, W.VA.
SUMMATION CURVE OF RUNOFF
Drainage Area 865 Sq. Miles

Drawn by T.M.C.	Jan. 24, 1916.
Traced by T.M.C.	Jan. 29, 1916.
Checked by J.W.C.	Jan. 31, 1916.

House Doc. No. 1792 ; 64th Cong., 2d Sess.

affected by backwater, and one woolen mill was swept away. One business establishment sustained $2,000 damage.

Shinnston, Harrison County (population, 1,500): A few houses were affected by backwater and one highway bridge was washed away, the damage amounting to about $8,000. No damage from floods has occurred since that time.

Monongah, Marion County (population, 2,200): Three or four houses were affected by backwater. One grist mill in this vicinity was washed away. There has been no other damage from floods.

There are a few coal mines along the lower West Fork, the openings of which have to be bulkheaded off at high stages. It is estimated that during high floods 12 of these mines have been closed, but, as a rule, no longer than one day at a time. The average daily output of each of these mines is 1,500 tons and the number of men employed 250.

The town of Fairmont on the Monongahela River, 1¼ miles below the mouth of the West Fork, has not been noticeably damaged by floods in the West Fork. In 1888 a few houses were affected by backwater, and one grist mill below Fairmont was wrecked, for which loss the Monongahela, also in flood, was largely responsible.

15. The greatest discharge at the mouth of the West Fork during this flood has been estimated (somewhat roughly) at 40,000 cubic feet per second, the greatest height at about 39 feet, and the flood's total discharge at 10,000,000,000 cubic feet. Since then there has been no high water at all comparable with this. Every two or three years the river attains a discharge of about 18,000 second-feet, and almost every year one of about 12,000. The average discharge is about 1,254 second-feet and the average low-water discharge about 70 second-feet.

TYGARTS RIVER.

16. Tygarts River is one of the chief tributaries of the Monongahela. The drainage basin is a valley 70 miles long with an average width of 20 miles. Its area is 1,365 square miles. It includes portions of Pocahontas, Randolph, Upshur, Barbour, Tucker, Preston, Taylor, Marion, and Monongalia Counties, West Virginia. The valley is rugged, with steep slopes and swift streams lying in deep gorges. Forty-three per cent of the surface is covered by forest. The basin of the Tygarts is in area 18⅔ per cent of the basin of the Monongahela.

17. The main stream rises in the southern part of Randolph County, W. Va., and flows in a general northerly direction to its junction with the West Fork River, with which it forms the Monongahela River 1¼ miles above Fairmont, W. Va. Its length is 118 miles and its total fall 3,240 feet. Beginning at its source, the Tygarts River has a fall of 293.7 feet per mile for 4.8 miles to Mingo Flat, and 49.5 feet per mile for 12 miles to a point about 5 miles above Huttonsville. For this distance of 16.8 miles the valley is narrow and thinly settled. The next 41 miles to Belington, W. Va., have a slope of 10.5 feet per mile. In this stretch, to a point about 3 miles below Elkins, there is almost continuous bottom land, much of it nearly a mile wide. This land is used very largely for stock raising. The slope for 11.6 miles below Belington is 31.4 feet per mile to the mouth of the Buckhannon River, the chief tributary. The valley is narrow and gorgelike. From this point to Philippi,

W. Va., a distance of 5 miles, the slope is 5.8 feet per mile; from Philippi to Grafton, 23 miles, the fall is 13.8 feet per mile; and from Grafton to the mouth there is a natural slope of 5.9 feet per mile. From the mouth of the Buckhannon River to Grafton the valley, although still bordered by steep hills, widens out into bottom land, or limited area, principally at and near Philippi, and at Grafton. Between Grafton and the mouth the hills again closely approach the stream.

18. The tributaries which are worth noticing are the following:

Name.	Length.	Average fall per mile
	Miles.	*Feet.*
Buckhannon River	61	31
Middle Fork River	38	39.
Three Fork Creek	41.5	26
Sandy Creek	15	93
Teters Creek	15.5	79

19. Rainfall observations have been taken at the following places:

Station.	Period of record.	Full years of record.	Mean rainfall.
			Inches.
Fairmont	[1] 1892-1913	22	42.77
Grafton	[1] 1892-1913	21	45.72
Philippi	[1] 1892-1913	21	47.08
Buckhannon	[1] 1889-1913	17	52.30
Elkins	[1] 1894-1913	20	49.86
Pickens	[1] 1877-1915	21	60.51

[1] Inclusive.

The mean for these six stations, 49.71 inches, is assumed to be the mean annual rainfall for the Tygarts Basin.

20. Gauge readings have been taken by the United States Geological Survey at the following places:

Belington	1907 to date.
Fetterman, W. Va	1907 to date.
Daily, W. Va	1915 to date.
Hall, W. Va. (Buckhannon River)	1907–1909 and 1915 to date.
Midvale, W. Va (Middle Fork River)	1915 to date.
Lock 15, Monongahela River	1904 to date.

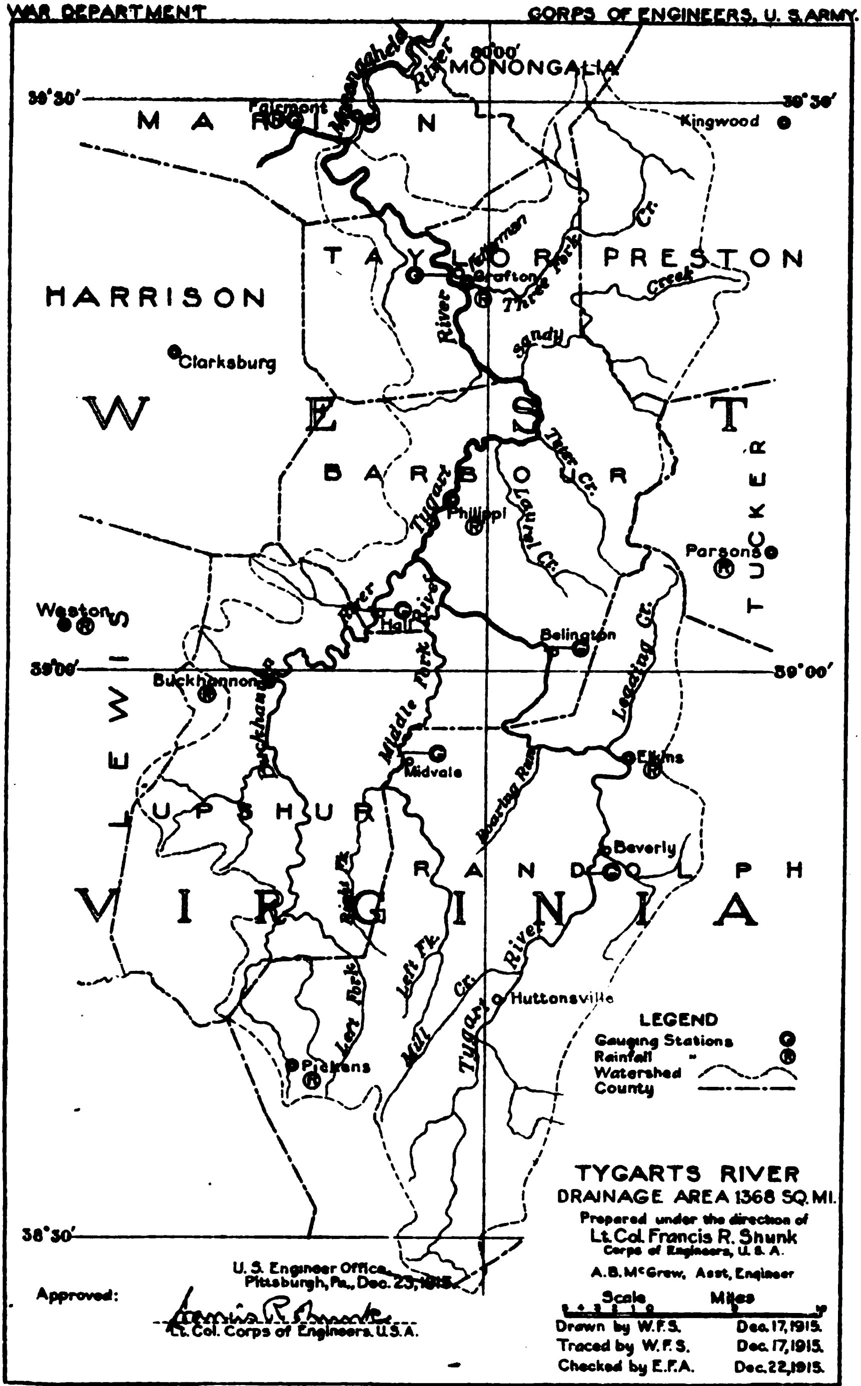
All of these gauges have been read twice daily. In addition, the United States Weather Bureau established a gauge at Elkins November 7, 1913, and continuous records are available to date. The gauge is read once daily. Since 1914 the work at the last four stations has been carried on in collaboration with the Pittsburg engineer office.

21. Discharge measurements sufficient for rating curves are available for two points only, namely, Belington and Fetterman. Flow at other points has been computed on the assumption that run-off is proportional to area drained.

22. Geological Survey maps are available for the entire basin, which is shown on portions of seven of the rectangular sheets, 13½ inches by 17½ inches, but these sheets are not all on the same scale.

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY.



LEGEND

Gauging Stations ⓖ

Rainfall " Ⓡ

Watershed

County

TYGARTS RIVER

DRAINAGE AREA 1368 SQ. MI.

Prepared under the direction of

Lt. Col. Francis R. Shunk

Corps of Engineers, U. S. A.

A. B. McGrew, Asst. Engineer

Scale Miles

5 4 3 2 1 0 5 10

Drawn by W.F.S. Dec. 17, 1915.

Traced by W.F.S. Dec. 17, 1915.

Checked by E.F.A. Dec. 22, 1915.

U. S. Engineer Office,
Pittsburgh, Pa., Dec. 23, 1915.

Approved:

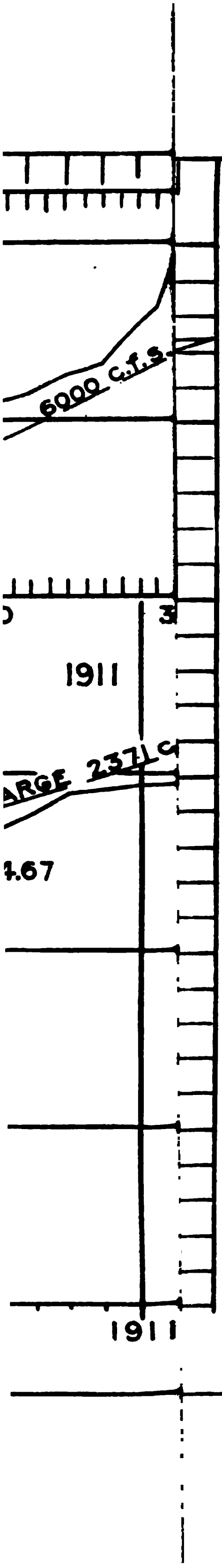
Francis R. Shunk

Lt. Col. Corps of Engineers. U. S. A.

THE NORRIS PETERS CO., WASHINGTON, D. C.

House Doc. No. 1792 ; 64th Cong., 2d Sess.

CORPS OF ENGINEERS, U.S. ARMY



TYGARTS RIVER
GRAFTON, W.VA.
SUMMATION CURVE OF RUNOFF
Drainage Area 1178 Sq. Miles

Drawn by T.M.C.	Jan. 24, 1916.
Traced by T.M.C.	Jan. 29, 1916.
Checked by J.W.C.	Jan. 31, 1916.

House Doc. No. 1792 ; 64th Cong., 2d Sess.

The scale of three of them is 1:125,000 and of the other four 1:62,500. They also differ in other particulars. Three of them have contours at vertical intervals of 100 feet, two at intervals of 50 feet, and two at intervals of 20 feet. These contours are quite sufficient to show the general character of the country. Besides these maps there are the post-route maps of Pennsylvania and West Virginia, which, so far as they go, agree with the Geological Survey maps but are not contoured. The map accompanying this report was traced from the post-route maps and is intended to show only the outline of the basin and the stations where measurements of rainfall and stream flow have been made.

23. No previous examination has been made by the United States with flood protection in view, nor has any examination been made with a view of determining the worthiness of the river for improvement as a navigable stream. There is no navigation on the Tygarts, nor does any seem likely.

24. From the characteristics of the basin it naturally follows that the Tygarts River is subject to sudden rises. By reason of the steepness of the hills and the considerable slopes of the tributaries water quickly accumulates in the streams after a rain, but, on the other hand, owing to the great slope of the main stream, it runs away as quickly. The banks being usually high, the river, although it may truly be said to be subject to rises, can scarcely be said to be subject to floods if overflow is thereby meant. However, the alluvial bottoms have been sometimes overflowed, and damage has been done to towns, especially during the flood of 1888, which is the highest on record.

25. The stage of each damaging flood on the Tygarts River, as far as ascertainable, at each important point along the stream is as follows:

	1888	1897	1912
	Feet.	*Feet.*	*Feet*
Belington	21	....	....
Philippi	26.5	29.1	29.7
Fetterman	29	....	....
At mouth	39	....	....

The stages given above for the flood of 1888 are not thoroughly trustworthy, having been obtained in part as the result of interviews with old settlers. It is not improbable that the stage given for Philippi is too low.

26. The greatest discharge at the mouth of Tygarts River during this flood has been estimated (somewhat roughly) at 58,000 cubic feet per second, the greatest height at about 39 feet, and the flood's total discharge at 15,000,000,000 cubic feet. Since then there has been no high water in Tygarts River at all comparable with this. Every two or three years the river attains a discharge of about 35,000 second-feet, and almost every year one of about 17,000. The average discharge is about 3,300 second-feet and the average low water discharge about 230 second-feet.

27. The principal towns along the stream with the flood damage sustained in their vicinity in the past are as follows:

Elkins, Randolph County (population 6,500): The Elkins Tannery in the flood of 1910, sustaind about $3,500 damage. In two rises in 1912, the damage

was about $7,000. In 1888 it sustained some damage, but not as much as in the later floods. The Elkins Box Co. was affected by the floods of 1910 and 1912. The 1910 flood also affected somewhat the Western Maryland Railroad above Elkins. In 1912 the tracks of the Coal & Coke Railroad were flooded at Elkins. In 1888 a railroad bridge at Roaring Creek Junction, about 8½ miles below Elkins, was wrecked. No houses seem to have been lost by floods, but in each of the last three floods about 25 houses were affected by backwater. The town was not built in 1888.

Belington, Barbour County (population 1,900): Here flood damage has not been great. In 1888 and three times since the main streets of town were flooded. In each flood an average of about 20 houses were affected by backwater. The total damage for the four rises is estimated at about $5,000. In 1888 a small house (value $500), 7 miles below town, was swept away.

Philippi, Barbour County (population 1,200),: In the 1888 flood a few small houses near the town were washed away. Stock in a grist mill was damaged to the extent of $5,000. In 1884 and 1888 about 20 houses, in 1897 about 30 houses, and in 1912 about 40 houses were affected by backwater. In 1888 a covered highway bridge in town was damaged to the extent of $600. An ice gorge in 1895 carried out a covered highway bridge at lower end of town (valued at $10,000). In 1912 a covered highway bridge at Moatsville, 10 miles below town, was swept away (value about $10,000).

In 1888 through railroad traffic between Grafton and Belington was interrupted for more than two months. Also in 1912 the railroad was damaged at and near Philippi, and traffic was interrupted for more than a week. It is estimated by one authority that the damage to the entire county of Barbour from the four floods mentioned amounted to about $200,000, and that the damage along the river in the county amounted to about $5,000 for each flood.

Grafton, Taylor County (population 8,500): In 1888 about 15 houses on the left bank of the river and about 20 houses along Three Fork Creek were affected by backwater. Some houses on left bank of river are understood to have been flooded once since 1888 and some houses along the creek about three times since 1888. A mill (value $2,000) about 4 miles above Grafton was swept away in 1888. The same flood carried away a covered bridge (value $10,000) at Fetterman, just below Grafton. Railroad tracks in town were under 4 feet of water. Tracks have since been raised.

In a flood of 1896 or 1897 the railroad bridge at the mouth of Three Fork Creek was carried out (value $5,000). In addition five other bridges at mouths of tributaries to river were swept out, value of each about $2,000.

Buckhannon, Upshur County (population 2,500), is the principal town on the Buckhannon River. In 1888 a few houses were affected by backwater and one highway bridge across the stream was carried away. There has been little damage since 1888.

Middle Fork River: In 1888 one highway bridge was swept away. There are no towns of importance on this stream and flood damage has been slight.

28. Nothing is known of any local conditions which intensified the flood of 1888 on the Tygarts River. The damage sustained was not great enough to justify preventive works of a general character.

CHEAT RIVER.

29. Cheat River is one of the chief tributaries of the Monongahela. The name is used only below the junction of Shavers Fork and Dry Fork, at Parsons, W. Va., 85 miles above the mouth, but Shavers Fork and Cheat River form virtually one stream. The drainage basin is a valley 102 miles long with an average width of 14 miles. Its area is 1,410 square miles. It includes portions of Pocahontas, Randolph, Tucker, Barbour, Preston, and Monongalia Counties, W. Va.; Fayette County, Pa., and a very small part of Garrett County, Md. The valley is rugged with steep slopes and swift streams lying in deep gorges. Sixty-nine per cent of the surface

is covered by forest. The basin of the Cheat is in area 19¼ per cent of the basin of the Monongahela.

30. The main stream, Shavers Fork and Cheat River, rises in Pocahontas County, W. Va., and flows in a northerly direction through Randolph, Tucker, Preston, and Monongalia Counties, crosses into Fayette County, Pa., and empties into the Monongahela at Point Marion, 3½ miles north of the State line. Its length is 157 miles and its total fall 3,720 feet. Beginning at its source, Shavers Fork has a fall of 50 feet a mile for 19 miles and 33.2 feet a mile for 53 miles. For this distance of 72 miles the river lies in a gorge with high and steep sides. The next 7 miles, to Parsons, W. Va., have a slope of 20.1 feet per mile. In this stretch the banks widen out occasionally and a little bottom land is found. At Parsons the Dry Fork comes in and the Cheat proper is formed. For the next 33 miles, to Rowlesburg, the fall is 8 feet per mile. It was chiefly in this stretch that rafting was carried on in past years. There is more bottom land here than anywhere else along the river, but its total area is quite limited. Most of it is under cultivation. From Rowlesburg to Albright, 14 miles, the fall is 14 feet per mile. There is a little bottom land here and there along the banks. Just below the latter town the stream enters a very narrow gorge, in which it flows to within 10 miles of the mouth. The slope for 11 miles below Albright is 24.9 feet per mile, to the mouth of Big Sandy Creek, the chief tributary. From this point to the mouth there is a natural slope of 6.8 feet per mile, but slack water from Dam No. 8, Monongahela River, extends about 1.75 miles up the Cheat. Just at the mouth there is some relatively level land, in which the town of Point Marion is built.

31. The tributaries which are worth noticing are the following:

Name.	Length.	Average fall per mile.
	Miles.	*Feet.*
Glady Fork	61	28
Laurel Fork	58	27.6
Gandy Fork	44	32
Black Water River	44	40
Dry Fork	68	30.5
Horseshoe Run	15	82
Big Sandy Creek	32	56

32. Rainfall observations have been taken since the year 1902 at Terra Alta, Brandonsville, Rowlesburg, Parsons, and Davis. The mean annual rainfall at these places from 1902 to 1913, inclusive, was as follows:

	Inches.
Terra Alta	52.04
Brandonsville	47.81
Rowlesburg	53.79
Parsons	48.30
Davis	40.80

The mean for these five stations, 48.55 inches, is assumed to be the mean annual rainfall for the Cheat Basin.

33. Gage readings have been taken, partly by the United States Geological Survey and partly by the Hydroelectric Co., of West

Virginia (which has begun the construction of a dam for power development near the mouth of the river), at the following places:

Ices Ferry	1902–1905 and 1908 to date.
Parsons	1912 to date.
Shavers Fork, just above Parsons	1910 to date.
Hendricks (Black Water River)	1911 to date.
Rockville (Big Sandy)	1908–1914.
Rowlesburg	1910–1914.

All these gages have been read twice daily. Since 1914 the work at the first four has been carried on by the Geological Survey in collaboration with the Pittsburgh engineer office.

34. Discharge measurements sufficient for rating curves are available for one point only, namely, Ices Ferry, where 34 sets of observations have been taken since 1902. Flow at other points has been computed on the assumption that run-off is proportional to area drained. The rating curve for Ices Ferry is herewith.

35. Since floods have been under consideration, during the seasons of 1913 and 1914, the river has been thoroughly examined by the officers and assistants of this district. Much information has also been obtained from other sources, as will be duly indicated.

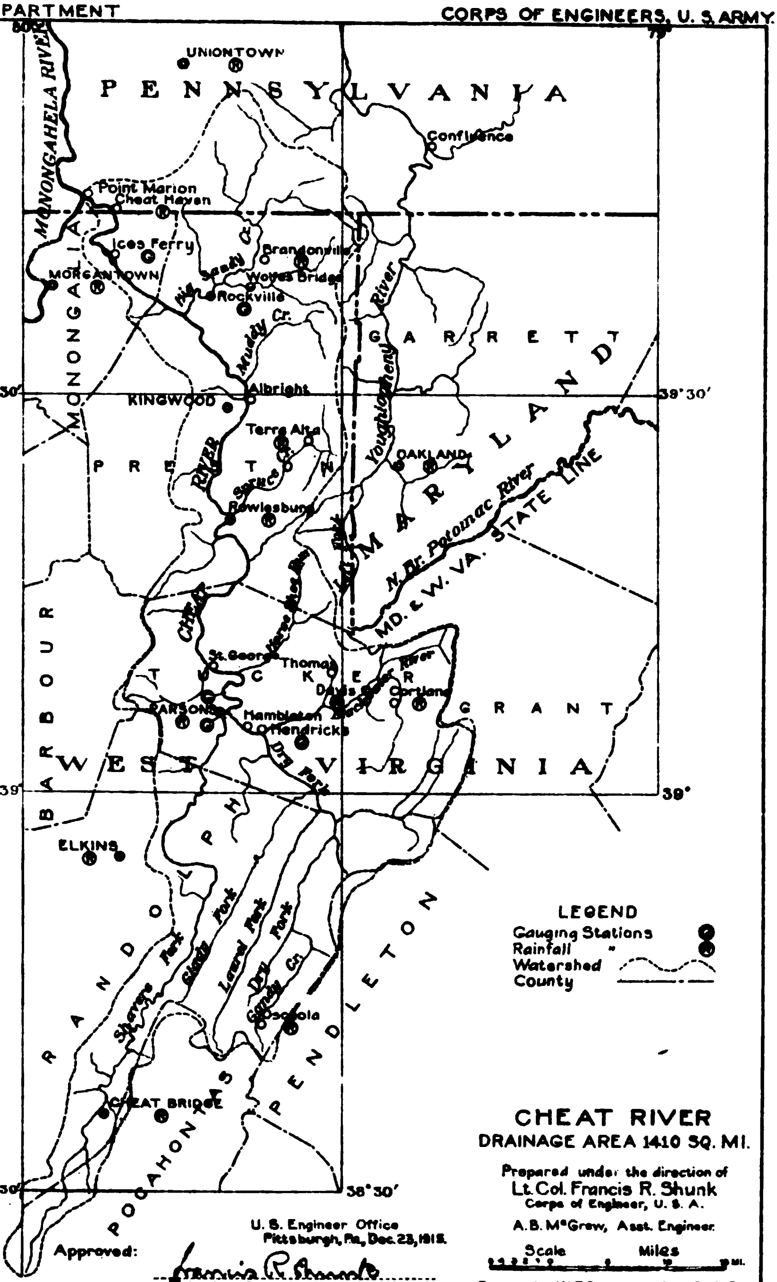
36. Geological Survey maps are available for the entire basin, which is shown on portions of 14 of the rectangular sheets 13½ by 17½ inches, but these sheets are not all on the same scale. The scale of five of them is 1:125,000, and of the other nine, 1:62,500. They also differ in other particulars. Five of them have contours at vertical intervals of 100 feet, four at intervals of 50 feet, and five at intervals of 20 feet. These contours are quite sufficient to show the general character of the country. Besides these maps there are the post-route maps of Pennsylvania and West Virginia which, so far as they go, agree with the Geological Survey maps but are not contoured. The map accompanying this report was traced from the post-route maps and is intended to show only the outline of the basin and the stations where measurements of rainfall and stream flow have been made.

37. No previous examination has been made with flood protection in view. Three examinations have been made with a view of determining the worthiness of the river for improvement as a navigable stream. The first of these is reported in the Report of the Chief of Engineers for 1889, page 1905. It recommends the removal of bowlders from the channel between Rowlesburg and the mouth at a cost of $13,000. This work was authorized and done. The second examination is reported in the Report of the Chief of Engineers for 1904, page 2538. It recommends that the river is not worthy of improvement. Report of the third examination was submitted October 7, 1907, and is to be found in the Report of the Chief of Engineers for 1908, page 593. This report also recommends that the river is not worthy of improvement. There is no navigation on the Cheat, nor does any seem likely.

38. From the charactertistics of the basin it naturally follows that the Cheat River is subject to sudden rises. By reason of the steepness of the hills and the considerable slopes of the tributaries, water quickly accumulates after a rain; but on the other hand, owing to the great slope of the main stream, it runs away as quickly. The banks being usually high, the river, although it may truly be said

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY.



CHEAT RIVER
DRAINAGE AREA 1410 SQ. MI.

Prepared under the direction of
Lt. Col. Francis R. Shunk
Corps of Engineer, U. S. A.
A. B. McGrew, Asst. Engineer.

Scale Miles
0 1 2 3 4 5 10 15 20 MI.

Drawn by W. F. S. Dec. 9, 1915.
Traced by W. F. S. Dec. 11, 1915.
Checked by

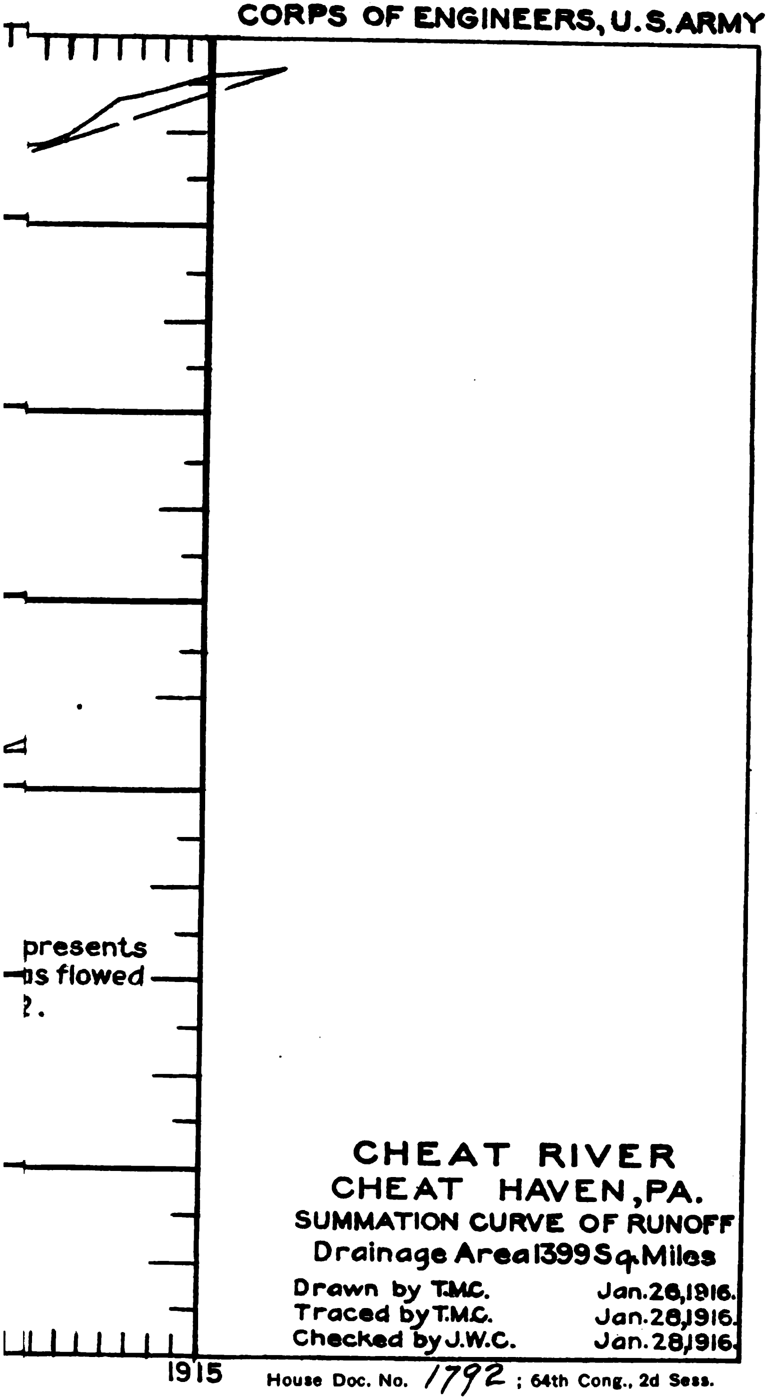
U. S. Engineer Office
Pittsburgh, Pa., Dec. 23, 1915.

Approved: Francis R. Shunk
Lt. Col. Corps of Engineers U. S. A.

THE NORRIS PETERS CO., WASHINGTON, D. C.

House Doc. No. 1792 ; 64th Cong., 2d Sess.

CORPS OF ENGINEERS, U.S. ARMY



CHEAT RIVER
CHEAT HAVEN, PA.
SUMMATION CURVE OF RUNOFF
Drainage Area 1399 Sq. Miles

Drawn by T.M.C. Jan.28,1916.
Traced by T.M.C. Jan.28,1916.
Checked by J.W.C. Jan.28,1916.

House Doc. No. 1792; 64th Cong., 2d Sess.

to be subject to rises, can scarcely be said to be subject to floods, if overflow is thereby meant. However, the alluvial bottoms have been sometimes overflowed, and damage has been done to towns, especially during the flood of 1888, which is the highest on record.

39. The greatest discharge at the mouth of the Cheat during this flood has been estimated (somewhat roughly) at 107,000 cubic feet per second, the greatest height at about 27 feet, and the flood's total discharge at 32 billions cubic feet. Since then there has been no high water in this river at all comparable to this. Every two or three years the river attains a discharge of about 40,000 second-feet, and almost every year one of about 20,000. The average discharge is about 3,300 second-feet and the average low-water discharge about 490 feet.

40. No figures are available of injury to farm lands, but the chief towns along the Cheat and the damage which they have suffered are as follows:

Davis, W. Va. (population, 2,600), is situated at headwaters of Dry Fork. No damage from floods to this time.

Thomas, W. Va. (population, 2,300), located on Black Water River about 15 miles above Parsons. No damage from floods.

Hendricks, W. Va. (population, 640): The only time there has been any damage from floods was during flood of 1888, when two houses were washed away.

Parsons, W. Va. (population, 2,000): County seat of Tucker County. Located at the junction of Shavers Fork and Dry Fork on the Western Maryland Railroad. Practically no injury due to floods with the exception of the 1888 flood, which cause damage amounting to $1,200 to $1,500.

St. George, W. Va. (population, 400): No damage from floods.

Rowlesburg, W. Va. (population, 1,200): During the 1888 flood 17 houses, 1 railroad bridge, and 1 road bridge were washed away, the damage amounting to about $15,000. No damage from floods has occurred since that time.

The town of Point Marion, at the junction of the Cheat and Monongahela, has not been noticeably damaged, but in 1888 6 million cubic feet of lumber were lost; for which loss the Monongahela, also in flood, was largely responsible.

41. Nothing is known of any local conditions which intensified the flood of 1888 on the Cheat River. The total damage was small and would probably not justify preventive works.

INFLUENCE OF WEST FORK, TYGARTS, AND CHEAT RIVERS UPON THE MONONGAHELA AND UPPER OHIO.

42. Nothing is known of any local conditions which intensified the flood of 1888 on the West Forks, Tygarts River, or Cheat River. Much of the damage was confined to small tributaries and no system of flood protection except very local treatment would prevent occasional damage on these small streams. Reservoirs will probably never be justified for local use alone, but might possibly be built for more general purposes and incidentally improve local conditions.

43. Three kinds of injuries to river traffic may result from floods; erosion of banks with consequent shoaling of channel, damages to the works in aid of navigation, and interruption of traffic because of flood conditions. It happens that in the Monongahela and upper Ohio damages of all three kinds have been very small. No erosion to speak of has taken place, the channels have been improved rather than otherwise by the flood currents, and no damage to property has

been done other than wetting river-wall power houses (which is foreseen and provided for) and entering the basements of lock houses. Part of the United States boat yard at Charleroi has been flooded at unusually high waters, but the resulting damage has been small. The average interruption of traffic due to floods has been, on the Monongahela, four days a year, and on the upper Ohio (where there are movable dams and open-channel navigation at high water) there has been no interruption that can well be estimated; coal tows, for example, have difficulty in landing when the banks are submerged, but they seldom want to. Ordinary floods in fact are welcomed on the Ohio as facilitating the towage of coal.

44. The basin of the West Fork is in area 12 per cent of the whole Monongahela Basin, and 39 per cent of the Monongahela Basin above the junction. It is a fair inference that the West Fork is on the average responsible for 39 per cent of the flood volume at Dam No. 15, just below its mouth, and for 12 per cent of the flood volume from the Monongahela.

45. The basin of Tygarts River is in area 18⅔ per cent of the whole Monongahela Basin and 61 per cent of the Monogahela Basin above the junction with the West Fork. Tygarts River is, therefore, on the average responsible for 61 per cent of the flood volume at its junction with West Fork, and for 18⅔ per cent of the flood volume of the Monongahela at the mouth of the latter.

46. The basin of the Cheat is in area 19 per cent of the whole Monongahela Basin and 34 per cent of the Monongahela Basin above the junction. The Cheat may, therefore, be considered as responsible for 34 per cent of the flood volume at Dam No. 8, Monongahela River, just below its mouth, and for 19 per cent of the volume of water which that river pours into the Ohio.

47. No analogous inference can be drawn as to the effect of the West Fork, Tygarts, or Cheat on high stages in the Ohio, since the Allegheny and Monongahela floods are seldom synchronous. There is, however, a rating curve for the Ohio at Davis Island Dam from which the influence of the West Fork and of Tygarts River at that place can be deduced. For example, one of the highest recorded floods at Pittsburgh for which we have simultaneous discharge records for the West Fork River occurred on February 16, 1908. The discharge at Davis Island at the maximum stage was 346,000 second-feet, and the gauge reading 29.1 (above low water). It has been estimated that it takes 42 hours for flood waters of the West Fork and of Tygarts River to reach Davis Island. Forty-two hours before the time of the greatest height at Davis Island the discharge of the West Fork was 6,500 second-feet. Subtracting this from the total discharge it is found that the gauge height would have been 28.7 feet. Therefore the West Fork waters probably raised this flood about 0.4. Forty-two hours before the time of the greatest height at Davis Island the discharge of the Tygarts River was 18,200 second-feet. Subtracting this from the total discharge it is found that the gauge height would have been 28 feet. Therefore the Tygarts's waters probably raised this flood 1.1 feet.

The observations which give the best results for determining the effect of floods in the Cheat River upon the stage of water in the upper Ohio were obtained at the time of the highest recorded flood at Pittsburgh, that of March 15, 1907. The discharge at Davis

Island at the maximum stage of this flood was 434,000 second-feet, and the gauge reading 34.2 feet (above mean low water). It has been computed in the United States engineer office at Pittsburgh that it takes 32 hours for flood waters of the Cheat to reach Davis Island. Thirty-two hours before the time of the greatest height at Davis Island the discharge of the Cheat was 27,000 second-feet. Subtracting this from the discharge in the Ohio it is found that the gauge height would have been 32.7 feet. Therefore the Cheat waters probably raised this flood at 1.5 feet.

The following table shows the effect of each of these rivers on a number of Ohio River floods:

Date.	Davis Island stage.	West Fork.		Tygarts.		Cheat.	
		Discharge.	Effect.	Discharge.	Effect.	Discharge.	Effect.
Dec. 4, 1905	22.2	....	....	....	....	12,000	0.8
Mar. 15, 1907	34.2	....	....	....	....	27,000	1.5
Feb. 16, 1908	29.1	6,500	0.4	18,200	1.1	20,000	1.2
Mar. 20, 1908	26.2	11,000	.7	8,300	1.6	10,000	.6
Jan. 31, 1911	23.9	20,000	1.3	35,600	2.3	38,000	3.5
Mar. 22, 1912	26.7	7,300	.4	11,600	.7	27,000	1.5
Jan. 9, 1913	29.8	15,000	.9	20,100	1.2	27,000	1.6
Mar. 28, 1913	29.1	15,500	.9	13,400	.8	18,000	1.1

Farther downstream the effect is, of course, less, and probably becomes very small below the Beaver.

48. The fact that the tributaries of the Monongahela need no protection against floods along their own length, but that any work that might be done would be for the benefit of the main streams below virtually imposes the method of treatment. Such devices as levees, straightening and deepening the channel, might give some local relief at a few points, but the nature of the country is such that the resulting benefit would be very slight, while on the other hand the undesired effect of such work to facilitate the delivery of water to points below would probably not be perceptible. The only method which could produce an appreciable result would be to build reservoirs. If reservoirs be not deemed feasible, there is nothing to be done.

49. There appear to be three good reservoir sites on the West Fork River; one at Monongah, 4 miles above the mouth; one about 7.5 miles above Clarksburg; and one on Elk Creek about 6 miles above Clarksburg. A dam at Monongah 75 feet high will give a storage capacity of 6 billions of cubic feet; one above Clarksburg 58 feet high, 3 billions; and one on Elk Creek 54 feet high, 1 billion; the total storage capacity being 10 billion cubic feet. If such reservoirs were used solely for protection against floods, it seems probable that floods in that part of the river at and below Clarksburg could be entirely prevented, and nothing in the way of a flood would issue from the West Fork River.

50. There are several good sites for reservoirs in the Tygarts Basin. The Pittsburgh Flood Commission in its report of 1912 mentions five: One on Sandy Creek, 2.1 miles above the mouth; one on Teters Creek, 1.2 miles above the mouth; one on the Buckhannon River, 8.2 miles above the mouth; and two on the Middle Fork River, about 3 and 7 miles, respectively, above the mouth. A dam

on Sandy Creek 116 feet high will give a storage capacity of 883 million cubic feet; one on Teters Creek, 91 feet high, 463 millions; one on Buckhannon River, 45 feet high, 1,765 millions; one at Middle Fork, No. 1, 107 feet high, 554 millions; and one at Middle Fork, No. 2, 47 feet high, 1,511 millions. The total storage capacity thus obtained will be 5.2 billions cubic feet. The capacities of these five reservoirs are not in proportion to the drainage areas above them. If such reservoirs were used solely for protection against floods they would afford partial control of about 50 per cent of the total drainage area of the Tygarts River and flood volumes at the mouth of the river would probably be reduced from 40 to 50 per cent. It is believed that the cost of these reservoirs would not be justified by the extent of the benefits to be derived from them.

51. There are good sites for reservoirs in the Cheat Basin. The Pittsburgh Flood Commission, in its report of 1912, mentions four: One at Cheat Haven, 3.5 miles above the mouth; one at Rowlesburg, 45.7 miles above the mouth; and two on Shavers Fork, 87.4 and 94.8 miles, respectively, above the mouth of the Cheat. A dam at Cheat Haven 113 feet high will give storage capacity of 5.737 billions of cubic feet; one at Rowlesburg, 136 feet high, 7.294 billions; one at Shavers Fork, No. 1, 104 feet high, 0.549 billions; and one at Shavers Fork, No. 2, 100 feet high, 1.701 billions. The total storage capacity thus obtained will be 15.3 billions cubic feet. If such reservoirs were used solely for protection against floods, it seems probable that floods in that part of the river below the uppermost reservoir (Shavers Fork, No. 2) could be entirely prevented and nothing in the way of flood would issue from the Cheat River.

52. The Hydroelectric Co. of West Virginia contemplates a system of three reservoirs to be used for power development only. The first of these in West Virginia, 3.5 miles above the mouth of the river, just across the State line from Cheat Haven, Pa., is to be created by a dam 100 feet high, and will have a capacity of 4 billions of cubic feet. Work on this dam was begun in November, 1912, but is now suspended. The second, at Beaver Hole, 15.5 miles above the mouth, is to have a dam 100 feet high and a capacity of 4.5 billions. The third, at Rockville, on Sandy Creek, is to have a dam 300 feet high and a capacity of something over 9 billions. The total capacity of the proposed three reservoirs will, therefore, be between 17 and 18 billions of cubic feet.

53. This system of reservoirs, if it should be used solely for the prevention of floods, would go far to prevent them in the Cheat River.

54. So far as known no reservoirs for water-power purposes have ever been contemplated on the West Fork, and it is improbable that there will be any, on account of the extreme low-water flow of this stream, which is in ordinary years about 70 second-feet, while during the drought of 1908 it was as low as 14 second-feet. Flowage rights would also be so expensive as to prohibit any such enterprise.

55. No reservoirs for water-power purposes have probably ever been contemplated on the Tygarts River, and it is unlikely that there will be any on the main stream, because it would be necessary to relocate some parts of the railroad which follows the stream throughout its length. The cost of this and other flowage rights would

probably prohibit any such enterprise. Small installations for power development might be constructed on some of the tributaries.

56. If, however, a system of reservoirs should be built for power purposes, they could not, even by hypothesis, be used for the prevention of floods. Power development requires that the discharge shall be fairly uniform, and shall not fall below a fixed minimum, and also that the available head of water shall not fall below a fixed minimum. These conditions are not always fulfilled, and a compromise between them is necessary. But no power company having a reservoir will willingly let the water in it fall below the adopted minimum, nor will they keep it near the minimum if they can help it. Regularity of flow is so important to them that whenever water is to be had they will certainly fill up the reservoir as far as they can, so as to provide for the times of small natural discharge. This is the proper way to manage power reservoirs, and it is idle to suppose that companies which have spent money for them are going to manage them otherwise. Of course the levels in the reservoirs will sometimes be unavoidably low, and if a heavy rainfall happens along at that time the vacant space is so much to the good. But the part played by power reservoirs in preventing floods must always be accidental and entirely involuntary.

57. The notion of material assistance from reservoirs built for power purposes being therefore dismissed, an investigation has been made to determine whether reservoirs can be built in the basins of the West Fork, Tygarts, or Cheat Rivers purely for flood protection, to estimate in a general way if the cost will be reasonable, and to find what benefits to navigation will result from them. In order to make the discussion complete, the ideal reservoir system will first be considered; that, namely, which will give total regulation, so that the regulated discharge will be constant at all times. Such a system, besides preventing floods in the stream below, would also be beneficial to navigation by increasing the low-water flow, and would lend itself (under conditions) to power development, which is favored by steady discharge.

58. Since the good effect of the reservoir is to be felt on the Monongahela rather than on the tributaries themselves, reservoir sites near the mouth are better than those higher up, and the first sites considered are those lowest down on each stream.

59. On the West Fork River the first site to be investigated is that at Monongah, 4 miles above the mouth. This site is favorable for a dam of considerable height. Nothing is known of the character of the foundation. Tables have been prepared and a curve plotted showing for any date the total amount of water that has flowed past Monongah since June, 1907. From this curve it is found that the average flow for the past eight years has been 1,254 second-feet. Assuming that the discharge at the dam is to be kept uniform and equal to this average, it is found that there must be storage capacity in the reservoir of 39,000,000,000 cubic feet. This would require a dam 135 feet high. Such a dam is perfectly feasible as far as its mere construction is concerned. Therefore the complete equalization of the flow from the West Fork is possible. Or, to be accurate, if such a reservoir had come into existence in the year 1907 and had been properly managed its capacity would not yet have been found insufficient. This reservoir would also take care of a flood

similar to that of 1888 (the greatest of record for the upper Monongahela basin), unless the reservoir was over three-fourths full, which is improbable.

60. A dam 135 feet high at Monongah would cause the submersion of 40 square miles, including valuable bottom land and all of the towns and villages to and including a large part of Clarksburg. About 40 mines, very extensively operated, would be flooded. The Baltimore & Ohio Railroad follows the right bank of the river from the mouth to about 5 miles above Clarksburg and the left bank from the mouth of Ten Mile Creek to Clarksburg. A total of about 52 miles of this railroad would have to be relocated. The Monongahela Valley Traction Co. operates an electric line, which follows the river from the mouth to the point where the Baltimore & Ohio leaves the river above Clarksburg. This also would have to be relocated. It is therefore manifest that the project will be very expensive. Therefore it seems prudent to reduce the requirements and see if a less complete solution will not answer.

61. The West Fork in its lower portion will readily carry a flow of 6,000 second-feet without overflowing its banks. This discharge is therefore assumed whenever it is possible—that is, whenever there is water stored in the reservoirs the flow is to be kept at 6,000 second-feet until the reservoirs are empty. This means that at times of flood 6,000 cubic feet per second will be discharged into the Monongahela instead of 1,254 second-feet, as with perfect equalization. But it must be assumed that other tributaries of the Monongahela are also controlled; and if they are, an additional 4,750 cubic feet will do no harm.

62. With this assumption as to flow a single reservoir at Monongah having a capacity of about 3.2 billion cubic feet would effect the control desired if there were no greater floods than have occurred since 1907, when the records began. It would not, however, take care of a flood similar to that of 1888, during which the total run-off was about 10 billions. Allowing for a discharge of 6,000 cubic feet per second a reservoir sufficient to impound the water of this flood must have a capacity of about 6.5 billions cubic feet. There is, then, some possibility that a large flood will occur when the reservoir is partially full. It is therefore deemed best to allow a margin of 33⅓ per cent for safety, so that the actual capacity required would be in the neighborhood of 9 billions of cubic feet. A dam for such a capacity would have to be 87 feet high. The area flooded would be 11¼ square miles. Such a dam is feasible as an engineering enterprise.

63. The cost of a reservoir having its dam at Monongah will be very high on account of the great damage to coal mines, railroad property, and villages. These conditions are not found to the same extent above Clarksburg and reservoirs can be built much more cheaply above that city. While the drainage area controlled would thus be reduced by nearly one-half, the cost would obviously be only a fraction of that of the reservoir at Monongah described in the preceding paragraph. A dam 65 feet high on the main stream just above Clarksburg and another 60 feet high near the mouth of Elk Creek would together control 54 per cent of the drainage area of the river. The board, therefore, concludes that the construction of the two reservoirs above Clarksburg offers the most feasible solu-

tion for the flood control of the West Fork River. The Pittsburgh Flood Commission in its report of 1912 also rejected the Monongah site, apparently on account of the excessive cost. Of course, the benefits to be expected will be reduced by 46 per cent.

64. The reservoirs contemplated in the preceding paragraph are to be emptied after each rise.

65. On the Tygarts River the first site to be investigated is one about three-fourths mile above Grafton, 20.75 miles above the mouth, as it is impracticable to inundate a city of that size. This site is favorable for a dam of considerable height. Tables have been prepared and a curve plotted showing for any date the total amount of water that has flowed past Grafton since June, 1907. From this curve it is found that the average flow for the past eight years has been 2,371 second-feet. Assuming that the discharge at the dam is to be kept uniform and equal to this average, it is found that there must be a storage capacity in the reservoir of 67 billions of cubic feet. Investigation discloses the fact that, in view of the topography and the steep slope of the river and its tributaries, the storage of this quantity of water, if not absolutely impossible, would certainly entail enormous expense. It is therefore necessary to reduce the requirements and see if a less complete solution will not answer.

66. One dam at Grafton, the best site near the mouth of the Tygarts, would control 86½ per cent of the drainage basin. It is estimated that 8,000 second-feet is the maximum flow that would occur from the uncontrolled area, even from excessive rainfall such as produced the flood of 1888, and that the ordinary flood flow would not exceed 5,000 second-feet. As the Tygarts in its lower portion will readily carry a flow of 14,000 second-feet without overflowing its banks, a discharge of 6,000 second-feet from the reservoir will do no harm. This discharge is therefore assumed whenever it is possible; that is, whenever there is water stored in the reservoir the flow is to be kept at 6,000 second-feet until the reservoir is empty. This means that in times of flood 11,000 to 14,000 second-feet (6,000 second-feet from the reservoir and 5,000 to 8,000 second-feet from uncontrolled area) will be discharged into the Monongahela instead of 2,371 second-feet, as with perfect equalization. But it is assumed that other tributaries of the Monongahela are also controlled; and, if they are, the additional discharge will do no harm.

67. With this assumption as to flow, a single reservoir at Grafton having a capacity of about 7.7 billion cubic feet would effect the control desired if there were no greater floods than have occurred since 1907, when the records began. It would not, however, take care of a flood similar to that of 1888, during which the total run-off was about 15 billions. Allowing for a discharge of 6,000 cubic feet per second, a reservoir sufficient to impound the water of this flood must have a capacity of about 12 billion cubic feet. There is, then, some possibility that a large flood will occur when the reservoir is partially full. It is therefore deemed best to allow a margin of 33⅓ per cent for safety, so that the actual capacity required would be in the neighborhood of 16 billion cubic feet. A dam for such a capacity would have to be 195 feet high. The area flooded would be 6.3 square miles. Such a dam is feasible as an engineering enterprise.

68. The reservoir contemplated in the second case considered is to be emptied after each rise.

69. On Cheat River the first site to be investigated is that at Cheat Haven, or State Line, 3.5 miles above the mouth. This site is favorable for a dam of considerable height, although the foundation may be somewhat expensive, the underlying rock being shale in approximately horizontal layers, with at least one vein of coal near the surface. Tables have been prepared and a curve platted showing for any date the total amount of water that has flowed past Cheat Haven since August, 1902. From this curve it is found that the average flow for the past 13 years has been 3,300 second-feet. Assuming that the discharge at the dam is to be kept uniform and equal to this average, it is found that there must be storage capacity in the reservoir of 118 billions of cubic feet. In view of the topography, the highest dam that good engineering would allow (324 feet) would give storage capacity of only 63.3 billions. A single dam at Cheat Haven will therefore not give complete equalization of flow.

70. The next best site is that at Rowlesburg, 45.7 miles above the mouth. Superficial inspection indicates that the foundation is good, but there have been no borings. Complete equalization at Rowlesburg can be obtained by a dam 325 feet high, which will give storage capacity of 75 billions of cubic feet. Such a dam is perfectly feasible as far as its mere construction is concerned. With this reservoir in existence, a dam at Cheat Haven 275 feet high, giving storage capacity of 43 billions, will complete the equalization of Cheat River. This dam also can be built. Therefore the complete equalization of the flow from Cheat River is possible; or, to be accurate, if such reservoirs as have been mentioned had come into existence in the year 1902 and had been managed as indicated, their capacity would not yet have been found insufficient. These reservoirs would also take care of a flood similar to that of 1888 (the greatest on record for the upper Monongahela Basin), unless the reservoirs were almost three-fourths full, which is improbable.

71. A dam 325 feet high at Rowlesburg would cause the submersion, when the reservoir was full, of 22.6 square miles, including valuable timberland and bottom land, and the towns of Parsons and Hambleton, with 1,780 and 1,300 inhabitants, respectively. A dam 275 feet high at Cheat Haven will flood about 12.7 square miles, including timber, agricultural land, and coal deposits. Experience indicates that the price to be paid will be high. The dams themselves will also be very expensive. Therefore it seems prudent to reduce the requirements and see if a less complete solution will not answer.

72. The Cheat, in its lower portion, will readily carry a flow of 10,000 second-feet without overflowing its banks. This discharge is therefore assumed whenever it is possible; that is, whenever there is water stored in the reservoirs the flow is to be kept at 10,000 second-feet until the reservoirs are empty. This means that in times of flood 10,000 cubic feet per second will be discharged into the Monongahela instead of 3,300 second-feet, as with perfect equalization. But it must be assumed that other tributaries of the Monongahela are also controlled; and if they are, an additional 6,700 cubic feet will do no harm.

73. With this assumption as to flow, a single reservoir at Cheat Haven having a capacity of about 7.6 billion cubic feet would effect the control desired if there were no greater floods than have occurred since 1902, when the records began. It would not, however, take care of a flood similar to that of 1888, during which the total run-off was about 32 billions. Allowing for a discharge of 10,000 cubic feet per second a reservoir sufficient to impound the water of this flood must have a capacity of about 26 billion cubic feet. There is, then, some possibility that a large flood will occur when the reservoir is partially full. It is therefore deemed best to allow a margin of 33⅓ per cent for safety, so that the actual capacity required would be in the neighborhood of 35 billions of cubic feet. A dam for such a capacity would have to be 255 feet high. The area flooded would be 11¼ square miles. Such a dam is feasible as an engineering enterprise.

74. The same result might be achieved by building two reservoirs, each of less capacity, one at Cheat Haven and one at Rowlesburg. Accurate design and estimate would be required to decide which plan is best.

75. The reservoirs contemplated in the second case considered are to be emptied after each rise.

76. It would seem from the proposed method of management that the reservoirs might be of the impeding or detention type, which regulates itself. The board would not, however, recommend this type, unless some means of control were provided to be used when necessary or other Ohio River tributaries were similarly regulated. Detention reservoirs decrease the flood height at the expense of a prolongation of the time of high water, and therefore necessarily increase the probability of coincidence of high stages from several tributary streams. In the present case let us suppose that the discharge of the Monongahela were regulated satisfactorily, as far as that river was concerned, by detention reservoirs in many of the tributaries. There would be no marked flood crest at Pittsburgh, but the time of high water would be considerably prolonged and might very well be met by a flood from the Allegheny which otherwise would be coincident with lower water on the Monongahela. As it is, floods in the two rivers seldom occur together. While therefore the detention reservoirs might work very well for 19 years, in the twentieth they might cause a worse flood than would happen without them. Even reservoirs under control might be difficult to manage, so as to escape such combinations, but the chance would be far better. The board therefore does not think that reservoirs incapable of control ought to be approved by the United States unless it can be demonstrated that the danger of increased flood heights by reason of their use is quite remote.

77. Although flood prevention and power control are in general antagonistic, there are ways in which these uses may be combined. For example (as has been sometimes proposed) a reservoir for flood prevention might be superposed on one for power development. But this would amount to having two reservoirs, since the upper part would have to be managed without reference to the lower part. Also, since the acreage overflowed increased rapidly with the height of the water, and the cost of the dam varies roughly with the square of the

height, there would probably be no economy in the combination. Such superposition would therefore have to be justified by special conditions and each case be worked out on its own merits.

78. The same reservoir may, however, in cases be used for flood prevention and power development. As an illustration it may be supposed that the reservoir at Rowlesburg, on Cheat River, has been built for perfect equalization. Then, while it will probably not be advisable, on account of the variable head (which occasionally reduces to nothing) to install turbines at the dam, the fall of 603 feet from Rowlesburg to the mouth might be utilized for power by intermediate dams, with the advantage of constant head and constant flow.

79. The board concludes that while floods have occasionally caused damage to railroads, bridges, and towns, the West Fork, Tygarts, and Cheat Rivers are not subject to frequent damaging floods. No great losses have occurred which would not have been largely prevented by local improvements, such as the raising of railroad tracks, bridges, and houses. A few bridges near Clarksburg, W. Va., on the West Fork, and railroad tracks at Grafton, W. Va., have been raised, and while no accurate data are available as to the total miles of railroads or the number of bridges now endangered in flood times, it is not believed that the cost of protecting them by the above methods would be great. Additional information in this regard might be desirable. Expensive works of flood prevention, such as reservoirs, if near the mouths of the streams, would not fully protect these rivers, nor is the damage in these valleys done by floods alone ($300,000 in the 25 years previous to 1913) great enough to warrant such expense. This $300,000 would have been less if roads, bridges, and houses had been placed at higher elevations. The board is also not prepared to say that a greater flood than any now of record may not occur and cause greater damage. The collection of full information bearing on this phase is most desirable.

80. The reduction of floods issuing from the West Fork, Tygarts, and Cheat Rivers to harmless limits is feasible, but the cost will be great. There is also the objection that regulation for flood prevention only may be an obstacle to power development in the Cheat, for which there is already an economic demand, and the adjustment of the two sets of interests will be a difficult problem. But the damage done by floods from the Allegheny and Monongahela Rivers in Pittsburgh alone ($17,000,000 in the 20 years previous to 1912) is great enough to warrant the construction of expensive works of flood prevention of some character by some agency. Whether this would be grade raising or reservoirs or channel widening, or some combination of these, should be the subject of further study.

81. No power developments seem likely to be contemplated on the West Fork or Tygarts Rivers. On the Cheat it is believed that flood regulation and power development may be satisfactorily combined and some assistance from power interests may be expected. For instance, a dam at Rowlesburg for flood regulation would prevent a waste of water at flood times, as only a fixed maximum of, say, 10,000 second-feet would be discharged. This would be beneficial to power developments below, as they would be able to utilize all of

the flood waters. The natural flow between flood-regulating periods from the Cheat less than the fixed regulated flow of 10,000 second-feet would be the same as if no flood regulation existed. Also the sites for power reservoirs at Cheat Haven on the Cheat and at Rockville on Big Sandy Creek would still be available for increasing the low-water flow of the Cheat for power purposes. It is thought that further study along this line should be made. This may develop a favorable plan by which a cheap power may be made available for a Government plant for the manufacture of nitrates.

82. The reduction of floods in these streams would be of relatively small benefit to navigation either in themselves or on the Monogahela and upped Ohio unless combined with flood-restrictive measures on other important tributaries of the Ohio River.

83. The board concludes therefore that the United States would not be warranted in the interest of navigation alone at this time in cooperating with the States and other communities and interests in devising or carrying out plans for flood protection on the West Fork, Tygarts, or Cheat Rivers, if other rivers were not also to be considered; but with a view to preventing the destruction of property and the interruption of large commercial enterprises in the Monongahela Valley, especially in the vicinity of Pittsburgh; and as a part of a comprehensive scheme of flood-restrictive measures on all of the important tributaries of the Ohio River, the possibilities of further study on these rivers is an important attribute. It is believed that the preparation of projects for the West Fork, Tygarts, and Cheat Rivers should not be entirely set aside, but while the preparation of projects for other tributaries to the Ohio River affording great benefits from flood-prevention works on the tributaries themselves as well as on the Ohio are being undertaken, these streams should be kept in mind and more accurate field examinations, additional power studies, particularly on the Cheat River, and more detailed estimates be made and the stream flow measurements now in progress continued in order that they may fit into any general scheme of flood prevention adopted for the Monongahela, Allegheny, and Ohio Rivers.

KANAWHA RIVER.

85. The Kanawha River, frequently termed the Great Kanawha to distinguish it from the Little Kanawha, a smaller tributary of the Ohio to the north, enters the Ohio at Point Pleasant, 265 miles by water below Pittsburgh. It is formed by the junction of the New and Gauley Rivers 97 miles above its mouth. The New River, however, and the Kanawha really form one stream, and the name should properly have been applied to both throughout their length. This main stream, or New River, rises in northwestern North Carolina almost directly south of the headwaters of the Tennessee and between the Tennessee and the Yadkin. It flows at first to the northeast between the parallel ridges of the mountains throughout the westerly portion of Virginia and then turning flows in a general northwesterly direction across the State of West Virginia. Its middle courses lie between the headwaters of the Monongahela system and the Little

Kanawha on the north and the Guyandot River Basin on the southwest. The total length from the head of New River to Point Pleasant is about 420 miles.

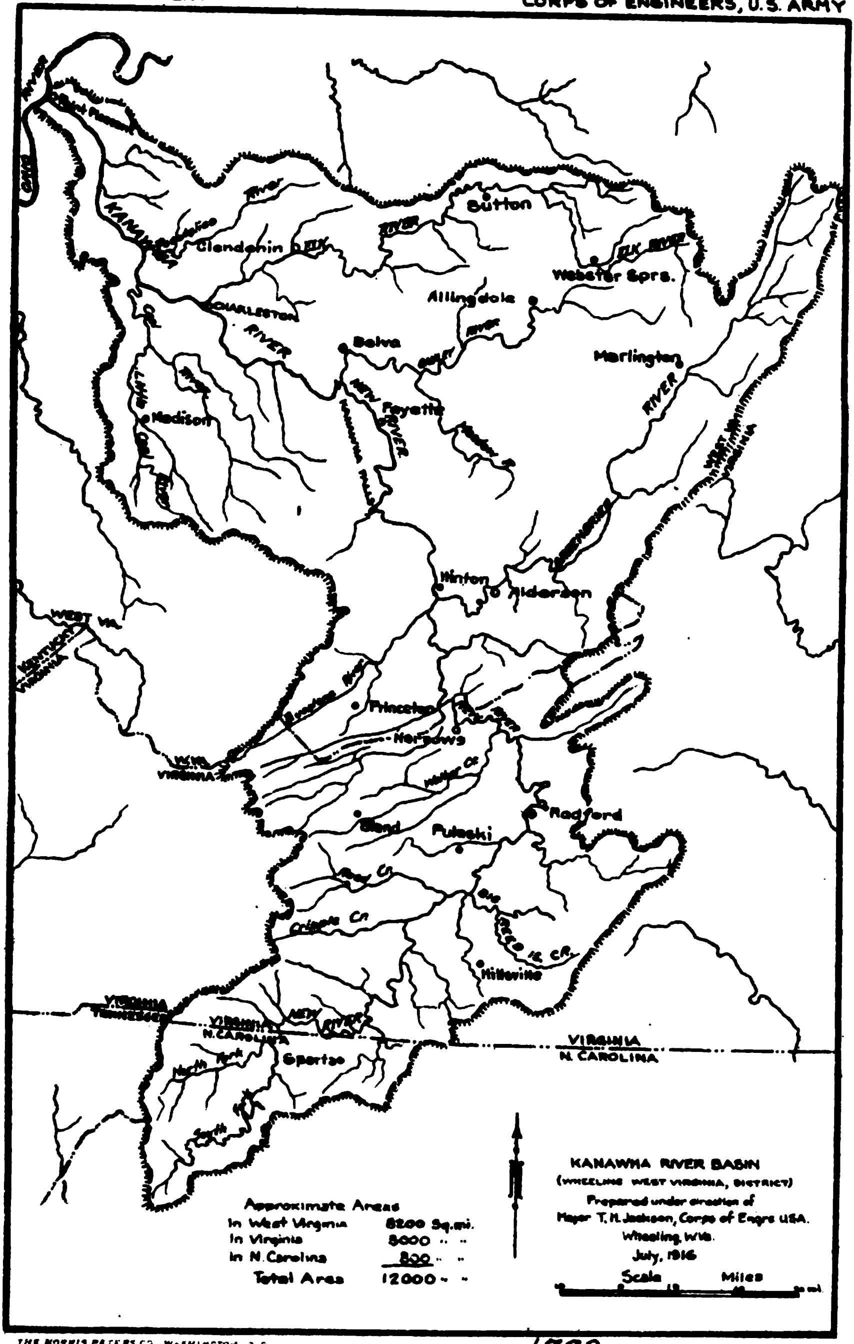
86. The total discharge area of the Kanawha is about 12,000 square miles, of which the New River drains almost exactly one-half, its watershed being computed at about 6,100 square miles. The other principal tributaries are the Gauley River, with drainage area of 1,500 square miles; Elk River, 1,600 square miles; and Coal River, 800 square miles. The drainage areas of the Kanawha in the different States are 800 square miles in North Carolina, 3,000 square miles in Virginia, and 8,200 square miles in West Virginia. The drainage areas above various points named in this report are approximately as follows: At Kanawha Falls, 7,600 square miles; at Charleston, 8,500 square miles; just below mouth of Elk River, 10,100 square miles; and at Point Pleasant, point of junction with the Ohio, 12,000 square miles. The Kanawha Basin approximates 30 per cent of the drainage area (40,700 square miles) of the Ohio above the mouth of the Kanawha.

87. Probably three-fourths of the land drained by the Kanawha is mountainous, with the remainder rough or rolling country. The river enters West Virginia at an elevation of about 1,000 feet and falls approximately 825 feet in the 90 miles to Kanawha Falls, or at the rate of more than 9 feet to the mile. The drop at Kanawha Falls is about 30 feet, and from there to the mouth, 94 miles, the fall is about 110 feet. The valleys are nowhere wide, and there are very few bottom lands worthy of the name above Kanawha Falls, and even below that point they do not average a mile in width. Owing to the nature of the country, the run-off after a rain is proportionally large and is also rapid, and as a result heavy rises or freshets have occurred at all seasons of the year and in every month except July and October. Highest water is, however, generally expected from January to April. The valley bottom begins to be overflowed when the river rises to about 30 feet at Kanawha Falls, to about 35 feet at Charleston, 58 miles from the Ohio, and to about 40 feet in the lowest courses, but outside of this limited extent of valley bottom there is little land affected by the water of the river even in highest flood stages. A portion of Charleston was formerly considerably affected, but the tendency has been to build on higher ground until now the mayor states that he does not believe the citizens would be interested in spending any money for flood protection. The coal mines are situated well above high-water levels and are not affected by floods in the river. The district engineer officer reports that the conditions of the bed and banks of this river are as nearly what they were before the country was developed as can reasonably be expected, and that it can not be said that the agency of man has been active in increasing the height of floods or the damage caused by them.

88. The lower portion of the Kanawha is subject to greater inundation by backwater from the Ohio River than it is from floods arising within its own basin.

89. Geological Survey maps are available for all sections of the Kanawha Basin except for a small portion of Virginia.

WAR DEPARTMENT CORPS OF ENGINEERS, U.S. ARMY



KANAWHA RIVER BASIN
(WHEELING WEST VIRGINIA, DISTRICT)
Prepared under direction of
Major T. H. Jackson, Corps of Engrs USA.
Wheeling, W.Va.
July, 1916

Approximate Areas

In West Virginia	8200 Sq.mi.
In Virginia	3000 " "
In N. Carolina	800 " "
Total Area	12000 " "

THE NORRIS PETERS CO. WASHINGTON, D.C.

House Doc. No. 1792 ; 64th Cong., 2d Sess.

90. The river has been the subject of several examinations and reports, as shown by the following list:

(1) An examination with surveys and estimates for the canalization of the river and for a canal connecting the Ohio River with the Atlantic Ocean by way of James River, published in the Annual Report of the Chief of Engineers, 1871, pages 625–650.

(2) A similar examination printed in Senate Document No. 25, Forty-second Congress, third session, and Chief of Engineers Report for 1873, page 508.

(3) An examination with regard to canalization, published in the Annual Report of the Chief of Engineers for 1875, part 2, pages 94–97. It is upon this report that the project for the improvement of the Kanawha, providing for a 6-foot navigable channel by the construction of movable and fixed dams and locks, was adopted by Congress by the act of June 12, 1875. The project was subsequently slightly modified, so as to change the number to 8 movable and 2 fixed dams with locks, which constitute the present completed project.

(4) An examination published in House Document No. 305, Fifty-eighth Congress, second session, to determine the advisability of extending the 6-foot channel to the falls by the construction of other locks and dams. The report was unfavorable.

(5) An examination, published in House Document No. 41, Sixty-third Congress, first session, to determine the advisability of increasing the channel depth from 6 feet to 9 feet. Report unfavorable.

91. The money expended upon the river in providing the 6-foot channel and upon previous projects amounted to $4,298,041.93. The expenditures for operating and care to June 30, 1915, were $1,571,419.29.

92. The work has been highly successful and the river possesses a large and important commerce, which is shown by articles and values for the calendar year 1914 in the following table:

Article.	Amount in customary units.	Amount in short tons.	Valuation.
Bricks	87,525	219	$656.44
Coal ... bushels	26,314,000	1,052,560	926,252.80
Dry goods	....	379	303,200.00
Farm products	....	7,275	167,325.00
Furniture	....	522	91,350.00
Gravel and sand	....	49,415	49,415.00
Groceries	....	8,923	1,561.525.00
Hardware	....	2,853	199,710.00
Hoop poles	142,875	857	1,428.75
Lath	169,700	51	509.75
Live stock	3,014	971	155,360.00
Poultry	20,435	41	16,348.00
Railroad ties	32,830	3,365	16,415.00
Salt ... barrels	1,410	197	1,269.00
Shingles	17,000	2	68.00
Staves	8,400	50	218.40
Sundries	....	8,445	1,182,300.00
Timber ... feet b. m.	1,323,538	2,647	19,853.07
Total	....	1,138,772	4,693,203.56

The year 1913 showed the largest traffic on record for the river. In that year 1,416,804 tons of freight, valued at $6,277,149.78, were carried.

93. The record concerning floods in the Kanawha River is very meager, but little information being available prior to 1890, except at Charleston, for which point it is fairly complete as far back as 1875.

94. The following table gives the heights, where known, of those floods arising from the waters of the Kanawha, which exceeded 35 feet at Charleston:

Date.	Kanawha Falls.	Charleston.	Lock No 11.
	Feet.	*Feet.*	*Feet.*
September, 1861	....	46.78	....
September, 1865	....	38.0	....
February, 1875	....	36.1	....
January, 1877	....	35.7	....
September, 1878	37.8	41.6	....
January, 1879	....	36.7	....
April, 1886	30.0	39.4	....
February, 1897	28.5	41.4	52.8
March, 1899	30.6	41.3	....
May, 1901	34.5	38.5	37.9
December, 1901	30.2	38.6	....
March, 1902	29.2	37.0	....

95. The flood of September, 1861, was the greatest which has occurred, so far as known, in the Kanawha Basin, but there is practically not much known concerning it except the record height of water. Having occurred before the establishment of the Government Weather Bureau, there are no data concerning the storm which caused it. The Ohio River not being in flood at this time, the effect on the lower river was not as great as has occurred several times from backwater from that stream. It is known that the flood of 1878 did some damage at Hinton, as shown by the Annual Report of the Chief of Engineers for 1879, Part I, page 536, which states that the river rose there to a height of 20.2 feet, washing away 16 buildings at Upper or Old Hinton and damaging a sawmill. The flood of February, 1897, appears to have done damage in the form of total or partial destruction of coal tipples, eight being carried away entirely, and also in injury to trestles of the Kanawha & Michigan Railroad.

96. Floods due to the Ohio River have risen above 40 feet at Point Pleasant, at the mouth of the Kanawha River, 22 times since 1883. The flood of 1884, with a height of 60, was the greatest from the Ohio until that of March, 1913, which rose to 62.8. The effect of this last flood upon the Kanawha is shown by the following table:

Elevation above sea level.

[Sandy Hook—Ohio River datum.]

Location.	Miles.	Top of bank.	Flood of 1913.	Low water.	Height of flood.
Charleston	58	....	593.5	559.7	33.8
Lock No. 6	54	602.0	590.9	552.8	38.1
Lock No. 7	44	591.0	....	543.8	....
Lock No. 8	36	576.2	580.0	535.5	44.5
Lock No. 9	25	567.7	577.0	527.8	49.2
Lock No. 10	19	574.5	577.0	521.6	55.4
Lock No. 11	2	557.2	76.8	514.3	62.5
Point Pleasant	0	559.2	576.8	514.3	62.5

This flood was caused by the two storms which passed over Ohio from March 23 to March 27, 1913, with the unprecedented rainfall of from 6 inches to 11 inches, except along a narrow strip on the southern edge of the State where it was about 4 inches, the second storm following the first so closely as to make really one storm in effect. The rainfall over the Kanawha Basin during this period was from 2 to 3 inches, an amount by no means excessive, and not sufficient to put the Kanawha itself in flood.

97. The damages from the earlier floods in the Kanawha River were comparatively unimportant, since the country had not developed to any considerable extent. As the country developed, there was a tendency to build the towns along the higher ground and out of reach of ordinary floods. This has limited the damage from flood waters principally to the farm lands and the railroads. The Chesapeake & Ohio Railway has been located so that it is not subject to injury from floods, and the raising and improving of the track of the Kanawha & Michigan has resulted in greatly lessening the injury to that line. In future it is probable that the bulk of the injury from overflow from floods will fall on farm lands. This will not be great in the case of floods in the spring, when there are no growing crops to be injured, but might be considerable in the case of floods like those of 1861 and 1878, which occurred in the fall season. In some cases houses built along the roads following the foot of the hills have been overflowed by floods arising from sudden and heavy cloudbursts on some of the smaller tributaries with narrow valleys and steep slopes. The damage was greatly increased in some of these instances by landslides blocking the stream, damming back the water to be let loose with a rush when the current cut through the obstruction. The floods of August, 1916, on Paint Creek, Cabin Creek, and Coal River were of this character. The estimated loss of life in these floods was 40 on Coal River and Cabin Creek. The total property damage was $5,000,000 to the railroads and mining operators. There were about 200 houses destroyed, valued at approximately $60,000.

98. Injury to the works of navigation by floods has been small and confined principally to the lock houses, shops, etc., where the flooding of the buildings has necessitated minor repairs. As to navigation proper, it has probably been confined to the time lost in having to lay up on account of the river being too high to load coal or ship any articles of commerce.

99. Very little reliable data are available concerning the discharge from the Kanawha at its higher stages. Gauging stations have been established at different points by both the United States Geological Survey and the United States Engineer Department. The data for rating curves have been obtained for the lower and medium heights of the river, but it will be necessary to wait for heavy freshets and floods before these curves can be materially extended. From the best available records it is estimated that the flow at Charleston varies from about 1,100 cubic feet per second at extreme low water to about 150,000 cubic feet per second at the 35-foot stage, and that the flow at the maximum recorded stage is probably about 215,000 cubic feet per second. The flow at the mouth of the river may not be increased proportionally to the increase of drainage area, and may even not be materially greater than the figures at Charleston on account of the narrowness of the lowest part of the basin, and the fact that any rain falling below Charleston may easily have passed on into the Ohio before the accumulated waters from the Kanawha's

upper tributaries arrive at that point. Furthermore, the matter is so complicated by the varying conditions of relative stages in the Ohio and Kanawha that no figure can be stated without knowing these conditions, for at one time practically all the waters of a moderate rise pass unchecked into the Ohio, while on the other hand, as occurred in 1913, the discharge at the mouth even when the Kanawha is in freshet stage may be for some time actually negative. At least two instances are known where the discharge from the Kanawha was sufficient to reverse the flow in the Ohio for a few miles above Point Pleasant, but unfortunately no definite data exist for this or other similar occurrences which have undoubtedly happened.

100. There are few rivers in the United States as little interested in protection against flood damage within their own basins as is the Kanawha. It has a well-established navigation channel within the limits where any navigation is practicable, and the works providing this channel are more economical in cost of construction and operation than any other system which might produce an equal effect could be. The coal-mine entrances are above flood level, and the railroads following the streams are now high enough above their waters to be indifferent to river stages. The mayor of the largest city upon the river says that it is not interested in floods or flood protection.

101. It appears therefore that the effect of the Kanawha River floods on the Ohio River, when the latter is at a high flood stage, is indirect. It adds to the crest height of the Ohio River and also to the duration of the flood, but it does so principally by the forced storage of its flood waters in its channel and the flood basins along the lower river, which storage would, under other circumstances, be available for Ohio River flood waters. The flood problem of the Kanawha River is, therefore, inseparably connected with that of the Ohio River and any control of the floods in the former may cause a corresponding decrease in the flood flow in the latter below Point Pleasant with a possible improvement of the flood conditions below that point. On the other hand, any decrease in the flood flow of the Ohio may decrease the height of the flood crest in the Kanawha in its lower portion. The flood waters from the Kanawha ordinarily reach the mouth of that river and enter the Ohio before the flood waters from the Allegheny and other tributaries at the upper portion of the watershed arrive at that point. It is therefore possible that the establishment of detention reservoirs in the Kanawha Basin by prolonging the flow from that stream might increase flood heights in the Ohio or prolong the period of flood. The character of the reservoirs which might be established as well as their size and location should receive the most careful study. It seems, therefore, that any surveys for the purpose of securing data for the preparation of a project for the control of the floods in the Kanawha River should be sufficiently extensive to permit the collection of such data as are needed in connection with the consideration of the flood problem of the entire Ohio River Basin and in the preparation of a comprehensive project for the control of its floods.

102. *Control of floods.*—It is evident from an examination of the data available that owing to the great height of the backwater from the Ohio River, the limited area to be protected, and the

limited value of the property in the overflow area, protection from floods by means of levees is impracticable, on account of excessive cost. There appears to be no solution of the problem of backwater from the Ohio River by works in the Kanawha River Basin alone. Such a solution must come from the control of the flood waters of the Ohio. An examination of the gauge records shows that were the floods originating in the Kanawha River reduced to such a point that the height of crest at Charleston would not exceed about 32 feet, little damage would result in future. The elimination of damage from floods originating in the drainage area of this river appears to rest in the storage of sufficient flood waters to reduce the crest at high stages about 10 feet. Such storage might eliminate danger of damage except by floods of the magnitude of that of 1861. An examination of the data given at other points in this report regarding discharge and storage will show that the possibility of obtaining such storage is very probable but whether or not such a scheme is advisable will undoubtedly depend on its cost, as shown by a survey. The problems of navigation, of flood, and possibly of water power are connected.

103. *Reservoirs.*—There is given below a list of a number of reservoir sites known to exist in the Kanawha River Basin, which reservoirs should be considered in connection with any project involving the storage of its flood waters. The approximate locations of these reservoirs are shown on the accompanying map.

Number on map.	Stream and location by county and State.	Area flow in line acres (Wheeling office).	Capacity of reservoir in 1,000,000 cubic feet.		Height of dam (M. O. Leighton).
			Wheeling office.	M. O. Leighton.	
1	Greenbrier River, Pocahontas County, W. Va	5,500	16,800	16,300	177
2	Elk River, Clay County, W. Va	18,700	60,000	49,900	190
3	Greenbrier River, Lewisburg, Greenbrier County, W. Va.	10,400	30,000	32,900	164
4	Meadow River, Greenbrier County, W. Va	7,300	12,700	8,000	80
5	Muddlety Creek, Nicholas County, W. Va	2,600	....	3,400	74
6	Blue Creek, Kanawha County, W. Va	1,100	2,500	3,300	97
7	Gauley River, Fayette County, W. Va	5,500	28,800	35,900	250
8	New River, Summers County, W. Va	7,800	20,000	20,300	135
9	Walker Creek, Giles County, Va	2,700	6,400	6,550	110
10	New River, Pulaski County, Va	21,200	56,000	59,400	125
11	Reed Creek, Wythe County, Va	4,500	9,700	6,400	100
12	Big Reed Island Creek, Pulaski County, Va	2,600	5,700	4,000	100
13	Cripple Creek, Wythe County, Va	3,000	6,500	2,900	109
14	New River, Carroll County, Va	6,300	20,700	19,400	200
15	Eighteen Mile Creek, Putnam County, W. Va	1,160	1,600	4,000	63
16	Thirteen Mile Creek, Mason County, W. Va	1,900	2,300	3,400	61
17	Pocatalico River, Kanawha County, W. Va	3,700	4,300	4,700	65
18	Coal River, Kanawha County, W. Va	20,800	....	40,580	128

Total area, 203 square miles.

104. The board concludes, therefore, that the United States would not be warranted, in the interest of navigation alone, at this time in cooperating with the States and other communities and interests in devising or carrying out plans for flood protection on the Kanawha River if other rivers were not also to be considered. As a part of a comprehensive scheme of flood restrictive measures on all of the important tributaries of the Ohio River, the possibilities of further study on this river is important. It is believed, while the prepara-

tion of projects for other tributaries of the Ohio River affording great benefits from flood prevention works on these tributaries themselves as well as on the Ohio are being undertaken, accurate field examinations, power studies, and more detailed estimates should be made and the stream-flow measurements now in progress continued in order that they may fit into any general scheme of flood prevention adopted for the other tributaries of the Ohio and the Ohio itself.

105. The board finds that the benefit to navigation of flood protection is a difficult matter to determine from the data at hand upon the tributaries of the Ohio River, which stream is now being provided with a continuous system of locks and movable dams. While the United States might not be justified in the interests of navigation alone in cooperating with the States and other communities and interests in devising or carrying out plans for flood protection on a stream considered by itself alone, the effect of each important tributary of the Ohio River upon the operation of the Ohio River dams and the resulting navigation of that important water highway is such that data concerning the flow of each of these streams, and especially of the flood flow, should be determined. On these grounds the board believes that the question of preparation of plans and the extent of cooperation should be fully investigated.

106. The Federal Government, through the Weather Bureau and other agencies, is already engaged in the collection and publication of information and data which will not only be of great value in the final solution of the flood problem but which now contribute materially in reducing the losses from floods by giving warnings of coming high waters, thus enabling property owners to undertake such rescue or preventive measures as time and circumstances permit. A further reduction in flood damage can, in the opinion of the board, be secured through the agency of the United States by the extension of the authority of the Federal Government so as to give it control over streams in the interest of flood protection, similar to that provided in the interest of navigation by the act approved March 3, 1899. Control over waterways in the interest of navigation has been limited to those channels susceptible of actual navigation and, to a certain extent, to an indeterminate area beyond, within which area control over the tributaries is necessary to the proper protection of navigation in the main channels. Control over waterways in the interest of flood protection must of necessity include practically the whole stream and its tributaries without any limitations imposed by any relationship to the interest of navigation.

107. The board, in prior reports, printed in House Document No. 246, Sixty-third Congress, first session, and No. 914, Sixty-third Congress, second session, endeavored to point out the practical impossibility of a proper control of streams for the purpose of flood protection when the dividing line between control by the United States by reason of relationship to the interest of navigation and control by the several States by reason of their sovereignty is incapable of exact or even approximate determination. It there stated (par. 16, Doc. 246):

> The board has been much impressed in its examination by the evils of divided control of the watercourses. The obstructions which have been placed along the various streams ought never to have been put there and their construction

should have been prevented, but since the control of rivers is in the twilight zone between the spheres of Federal and State authority, it developed that what was anybody's business was nobody's business, and no effective authority has been exercised by anybody. These rivers are feeders of a navigable stream and have an important effect upon the regimen of the Ohio River, and it is the opinion of the board that the authority of the United States should be exercised to prevent encroachments upon them exactly as in the case of navigable streams. It is believed that this is the only method of control which promises good results in practice. The board further urges that immediate steps be taken to exercise such authority, since bridges and other structures are to be rebuilt at once and there is evident danger in several places that they may be rebuilt in an obstructive manner.

108. Control over our waterways for the purposes of flood prevention and protection must, in the opinion of the board, be delegated to one central authority before any rational plan for flood control can be devised, and compliance with such plan, or other measures for the amelioration of flood conditions properly enforced. This central authority is logically and necessarily the Federal Government.

109. The board wishes to emphasize its opinion, however, that such control should preferably not be based on the uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that will accrue in the protection of life and property from loss and the interruption by floods of general interstate commerce and the interference with the mails.

110. No method of flood protection, even for a limited locality, should ever be adopted without a study of the effect of the proposed plan upon flood conditions in the stream both above and below the point where the contemplated changes are to be made. For it is evident that a plan considering only the local effect may have the result of increasing flood heights at other points. If the plan contemplates holding back the water at a certain point, the result can be secured only by damming it back at that point with consequent increase of height at localities immediately above. If it provides for an improved channel, or otherwise for increasing the rate of flow past the point, the result will be the pouring of more water in a given time upon the stream immediately below than it would otherwise have received, and a possible flooding of localities which might have escaped. No method changing the conditions at one point can be adopted without changing the conditions at other points, and care must be taken that while the beneficial effect is secured at one locality the results at the other localities affected are not unreasonably detrimental.

111. No method should be adopted without careful consideration and an accurate comparison between the value of the protection afforded on the one hand and the cost of the changes themselves combined with the damages to other localities on the other. A reservoir might be used to protect a community and the cost of the creating dam be reasonable, but the value of the land taken for the reservoir might make the cost of the remedy out of proportion to the trouble which it is intended to relieve. The building of levees may secure a community from high waters, but the increased flood heights at other points will involve the building of new levees or the giving of additional height and strength to old levees at other places, unless the trouble is to be merely transferred. The cost of these new levees and of the additions to the old ones thus becomes an item of the cost of protection which should receive consideration. Too often the plan

of flood protection adopted by one community is that selected solely for its relatively small cost and without the cooperation of or consideration for other parts of the river.

112. A dam either for impounding the water or restraining the flow can not be utilized without flooding a tract above it depending in area upon the height of the dam and the steepness of the ground. In very hilly or mountainous districts, as upon the tributaries of the Monongahela, the valleys will be deep and the reservoirs narrow and long while the value of the land for agricultural purposes will probably be small per acre, although where there are coal mines or coal deposits the mineral value of the land may be large. Where the land is only moderately hilly or rolling the dam will be less in height but the reservoirs will be much larger in area and shallower for a given capacity than in a mountainous region; the land will also probably be of higher value per acre, so that its cost will be high, if not excessive. It must also be remembered that the damage from floods is only occasional, in some instances even rare, but that the withdrawal of land for an impounding reservoir is immediate, continuous, and perpetual, while for a restraining reservoir its use is so modified and uncertain that its present and future value will be greatly impaired; thus a reservoir cost, which is in itself smaller than the money value of the protection it affords, may by its interest charges amount to much the larger sum in the course of a few years.

113. Most streams have low-lying lands along their course which are overflowed by the stream as soon as it rises beyond its banks. These lands, technically termed the "flood plain," form a natural reservoir of greater or less capacity depending upon their extent and the depth to which submerged.

114. Levees diminish the natural reservoir capacity of the stream. Where a flood overspreads the natural lowlands along a river the current across these overflowed lands is usually gentle compared with that in the stream channel, unless some artificial obstruction, such as road embankments or fills for other purposes, so contracts the waterway at some point as to cause a backing up of the water there. An overflow without strong current is seldom harmful to the land and is not ordinarily objectionable unless it enters buildings or occurs when crops are in the ground. On the Ohio and its tributaries floods have usually occurred too early in the season to interfere materially with crops, while along the lower Mississippi, owing to the earlier season in the more southern latitude and to the later arrival of the flood waters at this part of their course, the overflows are apt to damage or destroy the season's crops. Levees, by diminishing the natural reservoir capacity of the stream, throw the waters into the lower river more quickly and to a greater height than would otherwise occur. Levees of insufficient height or without proper channel capacity between them are liable to fail or be overtopped in excessive floods, with the resulting damage to large areas of the land which they were intended to protect, for the suddenly loosed waters either wash away the topsoil or cover it with a layer of sand and gravel. A levee built by a community for the protection of one side of a river only is rarely placed with any regard to the width of the waterway requisite to carry the flood flow or to the interests of the

property owners on the opposite bank unless the location is supervised by some competent authority. The board knows of one case where a drainage district recently built a levee along the banks of a river and so close to the stream that had the people on the opposite side built one similarly situated the area of the channel left between the two levees would have had a capacity sufficient for only one-fifth of the water carried in freshets occurring every few years. There is no method of flood protection requiring more intelligent supervision than the proper establishment of levees, and there is none for which one authority having jurisdiction throughout the length of the stream is so greatly needed to secure safe results, not only to protect one community against another but at times to keep a community from damaging itself, for an improperly placed or poorly built levee is certain to do one or both.

115. In those States which have a regularly organized commission or other body legally empowered to supervise plans for flood protection and to veto improper projects or hastily considered plans something can be done to prevent one community from injuring another, but in many States the people on one portion of a river have but little or no redress against the work detrimental to them which may be undertaken by the people upon another portion. Even where such a commission exists it is in many respects powerless to prevent constructions which are recognized as inadvisable and known to be dangerous. An instance which was recently brought to the attention of this board was that of the commissioners of a county building a bridge across a stream within the limits of a certain city. For economical reasons the bridge was made as short as possible and did not provide sufficient space underneath for the heavier floods to which the stream is liable. The city endeavored to prevent the building of the bridge and attempted to secure the adoption of some other plan which would not interfere with the high-water flow but was unsuccessful. The stream was not one regarded as ordinarily navigable, and appeal was not made to the War Department. It is doubtful if any State authority exists in most States to prescribe the amount of opening which must be left for the passage of flood waters at any bridge or in a railroad or highway embankment across the bottom lands adjacent to a river or to prescribe the height of such embankment, provided the proper openings are not made. Only Congress can exercise controlling authority where the questions arise between parts of a stream in different States.

116. It is probable that the Federal Government has control over conditions affecting floods in streams upon other grounds than the resulting influence upon navigation, although Congress has as yet not seen fit to exercise such control of nonnavigable rivers upon these other grounds. The flood of 1913 throughout the States of Ohio, Indiana, and Illinois interfered with mail communication and obstructed commerce between the States. The damage which this flood caused would have been lessened, and the interruption of commerce and of the transmission of the mails would have been less serious and of shorter duration had there been some supervision and control of the embankments and fills which had been made at will in the flood plains of the streams and of the encroachments which had been

made upon the stream channels. The same results occur in other floods and upon other rivers throughout the country, and as long as there is no authority to supervise constructions along the stream and none to enforce a reasonable regulation the interruptions of commerce and mail carriage will continue. That an excessive erosion upon a tributary which is not navigable will eventually produce conditions in the main stream which is navigable is probable, but the result is remote and depends upon so many contingencies of irregular occurrence that the connection between any particular encroachment or inadequate construction and a shoaling in the main stream is too remote to permit an enforcement of proper conditions upon the theory of effect upon navigation.

117. The board has already expressed its opinion that the devising of plans for flood protection on the West Fork, Tygarts, Cheat, and Kanawha Rivers can not be undertaken without the accumulation of further data than is now in its possession, and that this data should be secured, but it regards it as of prime importance as a first step in proper flood protection that the War Department which has in recent years endeavored to do all it could in the general interest of flood protection under existing laws, should have its hands further strengthened and supported by additional legislation. Congress has recently recognized the importance of this subject by creating a new committee upon flood protection and this board recommends that the authority of the War Department, which now exists upon navigable waters, be extended so as to give it supervision over all structures and constructions hereafter placed upon non-navigable streams which may unduly interfere with stream flow and increase flood heights and flood damages and interfere with interstate commerce.

118. To secure the data necessary for the preparation of flood protection plans called for under the act and for the exercise of proper supervision, the board recommends surveys as indicated for each of the streams named herein.

Lansing H. Beach,
Colonel, Corps of Engineers, United States Army.
Edgar Jadwin,
Lieutenant Colonel, Corps of Engineers, United States Army.
T. H. Jackson,
Major, Corps of Engineers, United States Army.
P. S. Bond,
Major, Corps of Engineers, United States Army.
Geo. R. Spalding,
Major, Corps of Engineers, United States Army.
W. P. Stokey,
Major, Corps of Engineers, United States Army.
Robert R. Ralston,
Major, Corps of Engineers, United States Army.

[For Report of the Board of Engineers for Rivers and Harbors see p. 6.]

PRELIMINARY EXAMINATION OF MUSKINGUM RIVER, OHIO, AND WABASH RIVER, ILLINOIS AND INDIANA.

War Department,
Office of the Division Engineer,
Central Division,
Cincinnati, Ohio, September 1, 1916.

From: The Ohio Valley Flood Board.
To: The Chief of Engineers, United States Army.
Subject: Report on preliminary examination of Muskingum River, Ohio, and Wabash River, Illinois and Indiana.

1. Pursuant to instructions contained in E. D. letter of December 14, 1915, the board of officers of the Corps of Engineers (constituted by S. O. No. 3, O. C. of E., 1913, as amended by subsequent orders) submits the following report on preliminary examination of Muskingum River, Ohio, and Wabash River, Illinois and Indiana.

2. This report is based upon information furnished the board by the district engineer officers in charge at Cincinnati, Ohio (second district), and Louisville, Ky., to whom the duty of making this preliminary examination was assigned by E. D. letter of April 16, 1915.

3. This examination was authorized by the following item of the river and harbor act approved March 4, 1915:

> Sec. 15. The Secretary of War is hereby authorized and directed to cause preliminary examination and surveys to be made at the following-named localities, and a sufficient sum to pay the cost thereof, as well as those included in section 14, may be allotted from the amount provided in this act: *Provided*, That allotments of such amounts as may be necessary may be made toward the completion of examinations and surveys heretofore authorized and for such other contingent expenses as are usually paid from the appropriation for "Examinations, surveys, and contingencies," to wit:
>
> * * * * * * *
>
> Muskingum River and its tributaries * * * in the State of Ohio; and the Wabash River and its tributaries, Illinois and Indiana; * * * with a view to devising plans for flood protection and determining the extent to which the United States should cooperate with the States and other communities and interests in carrying out such plans, its share being based upon the value of protection to navigation.

MUSKINGUM RIVER.

4. The Muskingum River is the largest river lying wholly within the State of Ohio. Its watershed area is approximately 7,797 square miles, or nearly one-fifth of the area of the State; its headwaters extend to within 25 miles of Lake Erie, where they interlock with those of the Cuyahoga, Black, Rocky, and Vermilion Rivers, emptying into the lake. The main drainage system of its basin consists of the Muskingum and its four principal tributaries, the Licking River 76 miles above its mouth, Wills Creek 97 miles above, and the Tuscarawas and Walhonding Rivers, which unite at Coshocton, 107 miles above, to form the Muskingum. The extreme length of the river is 225 miles. The watershed from the headwaters to almost the vicinity of Zanesville lies within the flat or gently undulating region of glacial drift spreading across the central portion of the State of Ohio. As will

be noticed by an examination of the map, practically all the tributaries of the river enter it at or above Zanesville. Although a considerable portion of the watershed lies to the east of Zanesville, the stream, Wills Creek, draining this section flows to the north and empties into the Muskingum about halfway between Dresden and Coshocton. During preglacial times the river evidently flowed westward along the general line of Wakatomika Creek to what is now the Scioto River and probably continued farther west. The westwardly course was probably changed by glacial drift, and the Muskingum then found a cleft in the hills forming the southern wall of its basin and opened a new course for itself through the rocky country southward to the Ohio River. The character of the watershed above and below Zanesville is therefore entirely different. In the upper portion the river valleys are shallow and broad, with comparatively extensive flood plains, usually 2 miles or more in width. At Zanesville the river passes through a rock gorge, the hills on the opposite sides of the river being abrupt and close to each other, while the bed of the river, its banks, and the steep hills are composed of solid rock. Below Zanesville the hills continue to be rocky and abrupt and follow the river banks closely, in many cases the distance between the top of the bank and the foot of the hill being hardly more than sufficient to accommodate the wagon road along the stream, while, except in a few isolated spots, it is doubtful if the flood plain anywhere exceeds 500 yards in width. The approximate lengths, drainage areas, and gradients of the Muskingum and its four principal tributaries are as follows:

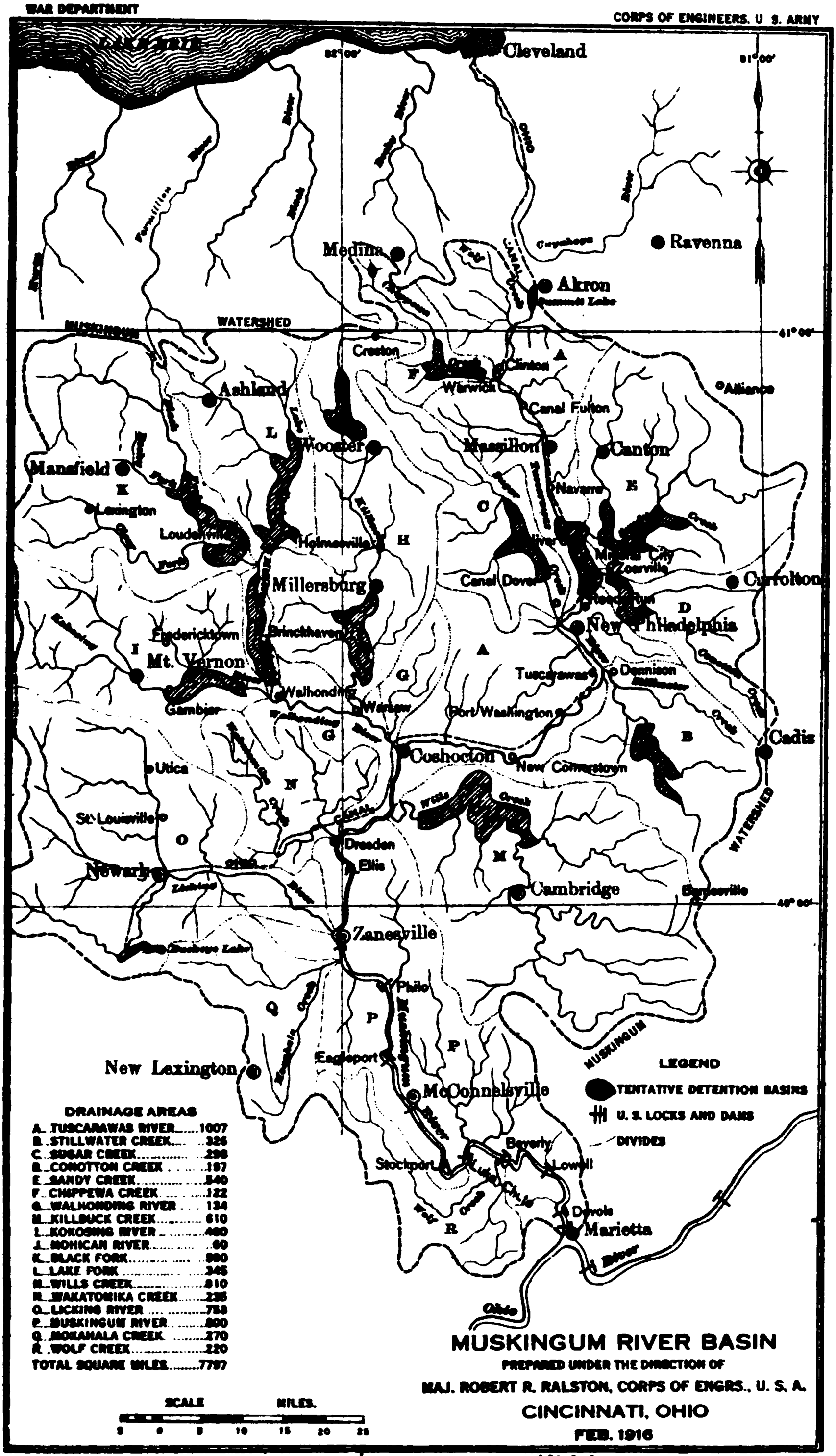
TABLE I.

Stream and location.	Length.	Fall.	Fall per mile.	Watershed.
	Miles.	*Feet.*	*Feet.*	*Sq. miles.*
Muskingum River	107	180	1.7	1,525
Licking River	69	625	9.0	[illegible]
Wills Creek	81	370	4.5	830
Tuscarawas River	118	426	3.6	[illegible]
Stillwater Creek	54	260	4.8	325
Conotton Creek	34	180	5.3	[illegible]
Sandy Creek	35	200	5.7	540
Chippewa Creek	26	47	1.8	122
Sugar Creek	45	286	6.3	[illegible]
Walhonding River	22	80	3.6	134
Killbuck Creek	80	390	4.9	[illegible]
Kokosing River	51	320	6.2	[illegible]
Mohican River	23	75	3.3	[illegible]
Black Fork	47	210	4.5	[illegible]
Lake Fork	37	190	5.1	365
Total				[illegible]

4½. The upper, or flat, portion of the watershed above Zanesville lay in the line of greatest rainfall during the storm of 1913 and no point in this part of the Muskingum Basin experienced a less precipitation than 6.2 inches, the whole area being subjected to a rainfall varying from this amount to 10.6 inches. All this water converged in the river valley just above Zanesville and had to pass through the gorge at that locality. This concentration of flow caused the water to rise to a height of 51.8 feet on the gauge, or 44.8 feet above low

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



DRAINAGE AREAS

A. TUSCARAWAS RIVER	1007
B. STILLWATER CREEK	326
C. SUGAR CREEK	298
D. CONOTTON CREEK	197
E. SANDY CREEK	540
F. CHIPPEWA CREEK	122
G. WALHONDING RIVER	134
H. KILLBUCK CREEK	610
I. KOKOSING RIVER	480
J. MOHICAN RIVER	60
K. BLACK FORK	590
L. LAKE FORK	345
M. WILLS CREEK	810
N. WAKATOMIKA CREEK	235
O. LICKING RIVER	753
P. MUSKINGUM RIVER	800
Q. MOXAHALA CREEK	270
R. WOLF CREEK	220
TOTAL SQUARE MILES	7797

MUSKINGUM RIVER BASIN

PREPARED UNDER THE DIRECTION OF

MAJ. ROBERT R. RALSTON, CORPS OF ENGRS., U. S. A.

CINCINNATI, OHIO

FEB. 1916

THE NORRIS PETERS CO., WASHINGTON, D. C.

House Doc. No. 1792 ; 64th Cong., 2d Sess.

water, and 15 feet greater than ever before. As Zanesville is the second oldest town in the State, information upon this point is as extensive as the white people's occupation of Ohio. The regular channel of the river being unable to contain the flow, the river, as it continued to rise, took a short cut through the business portion of the town. All small frame buildings in this section were destroyed or floated away bodily and some brick buildings were destroyed. All bridges crossing the Muskingum except the Y-bridge were demolished. This bridge, although completely submerged, withstood the strain. There was no loss of life. The crest of the flood occurred on Thursday morning, March 27, but it was not until Sunday, March 30, that the streets and railroad tracks emerged from the water.

5. For previous reports upon this waterway reference is invited to page 114, House Document No. 1491, Sixty-third Congress, third session.

6. The Muskingum is the only one of the streams in the Muskingum watershed that is navigable and was improved by the State of Ohio from 1837 to 1841 by the construction of 11 dams, 12 locks, and 5 short lengths of canal, at a cost of approximately $1,500,000, creating 91 miles of slackwater from its mouth to Dresden, Ohio.

7. These improvements remained under charge of the State of Ohio until 1887, when, pursuant to Federal legislation and cession by the State, they were taken in charge by the United States which has repaired, maintained, and operated them to date.

8. The operations of the United States for the improvement of navigation on this stream since taking it in charge have consisted in the construction of an ice harbor at its mouth, in connection with the improvement of the Ohio River, but which involved the construction of a new Lock, No. 1, under appropriations aggregating $340,500; work of repair, construction, etc., under specific appropriations for the Muskingum River aggregating $307,300, and repair, maintenance, and operation under allotments from the indefinite appropriation for operating and care, the expenditures from which to June 30, 1915, aggregate $2,273,740.47.

9. Other special work authorized by Congress on a protection wall at Zanesville, Ohio, and on the piers of bridges at Marietta, Ohio, and Taylorsville, Ohio, involved additional expenditures from the indefinite appropriation of $17,934.80.

10. The works of improvement are now in good condition and a 6-foot slackwater depth extends from the mouth at Marietta, Ohio, a distance of 91 miles to Dresden, Ohio, where a connection is made with the "Ohio Canal," a State waterway now out of commission, running to Lake Erie, at Cleveland, a distance of 144 miles.

11. At eight of the dams of the Muskingum River water power is leased from the United States for commercial purposes.

12. When this river was taken in charge by the United States, through navigation was interrupted by reason of the condition of the locks and dams. Since the works have been repaired and operated by the United States the average annual commerce on this stream has been some 60,000 tons. The following statements for the calendar years 1912, 1913, and 1914 are representative, though the de-

crease shown both in tonnage and value for the calendar years 1913 and 1914 may be attributed to the flood of 1913:

Calendar year.	Commerce.	Valuation.	Passengers.
	Short tons.		
1912	66,214	$3,219,764	45,[illegible]
1913	61,755	1,294,080	26,[illegible]
1914	61,773	1,081,747	26,[illegible]

13. It is probable that an increase in the annual traffic may be expected after the Ohio River dams from No. 1 to No. 20 are completed. It is estimated that these dams will all be in operation some time in 1917.

14. The following is a statement of extreme flood heights, elevations of floods which become damaging, and low-water elevations at points on the main stream and its tributaries, so far as it was practicable to secure authentic record:

TABLE II.

Stream and locality.	Elevation.		Extreme flood heights.								
	Low water.	Damaging flood stage.	Feb., 1832.	Apr., 1860.	Feb., 1884.	Mar., 1898.	Jan., 1904.	Mar., 1907.	Mar., 1910.	Mar., 1913.	July, 1913.
Muskingum River:											
Marietta	583.2	602.0	617.2	612.4	621.3	615.6	610.7	619.5	609.9	627.1	[illegible]
McConnelsville	640.5	660.0	670.0	667.0	669.0	669.5	661.2	660.0	667.7	684.0	[illegible]
Zanesville [1]	672.9	690.7	700.2	698.8	699.7	702.5	692.9	697.6	698.4	717.4	[illegible]
Coshocton	735.3	750.0			758.9	760.9	752.8	755.3	755.4	766.4	745.6
Tuscarawas River:											
Canal Dover	859.0	866.7				879.0				885.6	
Zoarville	866.2	875.0				886.0				891.2	
Massillon	914.0	924.0				934.0				940.0	
Warwick	943.1	951.0				959.0				965.0	
Reeds Run						878.0				882.2	
Sandyville	905.0	913.0				914.0				920.0	
Walhonding River:											
Walhonding	815.3	823.0				836.0				844.0	
Killbuck	795.0	803.0				806.0				810.7	
Millersburg	806.5	814.0				817.0				821.5	
Brinkhaven	860.0	869.0				874.0				881.7	
Loudonville	933.2	941.0				946.5				954.6	
Mount Vernon	974.1	981.0				986.5				988.0	
Mansfield	1,133.0	1,139.0				1,140.5	1,149.2[2]			1,142.7	
Wooster	848.0	855.0				857.0				860.4	
Lake Fork	898.0	908.0				920.0				927.2	
Lexington	1,162.0	1,170.0				1,191.0				1,200.0	
Wills Creek:											
Cambridge	770.0	785.0						796.0		794.2	

[1] The zero of the Zanesville gage is 665.9.
[2] Local storm.

15. The greatest and most destructive flood in the history of the river occurred in March, 1913; it was caused by excessive and widespread rainfall over the upper 6,714 square miles of its drainage area. From March 23 to 27 the average fall was about 7.2 inches on ground already saturated by 1.7 inches falling during the preceding 18 days. The rainfall was especially heavy March 24 to 25, from 3 inches to 5.6 inches falling in 24 hours at some sta-

tions. The mean temperature for the month was about 42° F. It is estimated that 90 per cent of the rainfall from March 23 to 27 ran off, and that the total run-off from this rainfall for the 6,714 square miles area above Zanesville was 108,192,000,000 cubic feet and for the entire watershed of 7,797 square miles 119,388,000,000 cubic feet. The foregoing estimated run-offs were from the excessive rainfall of March 23 to 27 only, as calculated from precipitation records and drainage areas. They should be increased by an amount equal to the normal discharge of the stream for the assumed period of run-off in order to obtain the total discharge. If we assume this period to be March 24 to April 4, inclusive (12 days), about 7,200 million cubic feet should be added to the foregoing estimate, making the total discharge for this period at Zanesville 115,392 million cubic feet and at the mouth of the river 126,588 million cubic feet. The estimated maximum flow at Zanesville was about 300,000 second-feet; at mouth of river about 325,000 second-feet. The following table shows the gage heights and corresponding discharges at Zanesville from March 24 to April 1, 1913, when the river had fallen below danger stage, as established by the Weather Bureau, or 25 feet on the gage:

TABLE III.

Date.	Gage reading.					Discharge.		Remarks.
	6 a. m.	6 p. m.	6 p. m.	6 a. m.	Mean.	Second-feet.	Total for 12 hours.	
1913.							*Million cubic feet.*	
Mar. 24	9.9	11.0			10.3	6,800	293	Mean of 4 readings.
Mar. 24-25			11.0	21.2	16.1	22,800	985	Mean of 2 readings.
Mar. 25	21.2	28.0			25.7	57,200	2,471	Mean of 4 readings.
Mar. 25-26			28.0	39.0	33.5	98,000	4,233	Mean of 2 readings.
Mar. 26	39.0	48.0			43.5	180,000	7,776	Mean of 4 readings.
Mar. 26-27			48.0	49.3	48.7	248,000	10,713	Mean of 2 readings.
Mar. 27	49.3	51.8			50.6	280,000	12,096	Do.
Mar. 27-28			51.8	51.8	51.8	300,000	12,960	Do.
Mar. 28	51.8	50.0			50.9	284,000	12,248	Do.
Mar. 28-29			50.0	47.0	48.5	246,000	10,627	Do.
Mar. 29	47.0	44.0			45.5	204,000	8,813	Do.
Mar. 29-30			44.0	39.0	41.5	160,000	6,912	Do.
Mar. 30	39.0	33.2			35.3	110,000	4,752	Mean of 3 readings.
Mar. 30-31			33.2	30.0	31.6	86,800	3,750	Mean of 2 readings.
Mar. 31	30.0	27.2			28.6	70,800	3,058	Mean of 4 readings.
Mar. 31-Apr. 1			27.2	24.5	25.9	58,000	2,505	
Apr. 1	24.5	22.2			23.3			Average rainfall over watershed Apr. 1 and 2, about 0.5 inch.
Apr. 1-2			22.2	20.2	21.2			
Apr. 2	20.2	18.0			19.5			
Total up to Apr. 1							104,192	

Zero of gage at Zanesville is 7.0 feet below low water.

16. This flood was followed in July, 1913, by floods in Wills Creek and other tributaries in the southeastern part of the watershed. These were caused by excessive rainfall in this locality, as much as 6 inches in 12 hours being recorded, and the flood heights reached in these tributaries in some cases exceeded those of the flood of March, 1913, by 5 feet.

17. Tables showing the characteristics of the floods of March, 1913, and July, 1913, are given below:

TABLE IV.—*Rainfall for period Mar. 23–27, 1913 (120 hours), and resulting run-off.*

Stream.	Watershed area.	Average rainfall.	Average run-off.	Total run-off.	
	Sq. miles.	*Inches.*	*Inches.*	*Million cu. ft.*	
Tuscarawas River:					
Stillwater Creek	326	4.5	4.0	3,067	
Sugar Creek	298	8.5	7.6	5,297	
Conotton Creek	197	5.2	4.7	2,168	
Sandy Creek	540	7.0	6.3	7,908	
Chippewa Creek	122	9.0	8.1	2,171	
Minor tributaries, etc	1,007	7.8	7.0	16,317	36,923
Walhonding River:					
Killbuck Creek	610	9.5	8.5	12,116	
Kokosing River	480	8.0	7.2	8,028	
Mohican River	60	9.0	8.1	1,128	
Mohican River, Black Fork	590	10.5	9.5	12,952	
Mohican River, Lake Fork	345	10.1	9.1	7,304	
Minor tributaries	134	7.5	6.7	2,101	43,629
Muskingum River above Zanesville:					
Wills Creek	810	6.0	5.4	10,161	
Wakatomika Creek	235	7.0	6.3	3,429	
Licking River	753	7.0	6.3	11,020	
Minor tributaries, etc	207	7.0	6.3	3,030	27,640
Total	6,714				108,192
Muskingum River below Zanesville:					
Moxahela Creek	270	6.0	5.4	3,386	
Wolf Creek	220	3.5	3.1	1,610	
Minor tributaries, etc	593	5.0	4.5	6,200	11,196
Grand total	7,797				119,388

TABLE V.—*Rainfall for period July 14–15, 1913 (48 hours), and resulting run-off.*

Stream.	Watershed area.	Average rainfall.	Average run-off.	Total run-off.
	Square miles.	*Inches.*	*Inches.*	*Million cubic feet.*
Tuscarawas River	[1] 100	2.0	1.8	418
Stillwater Creek	[2] 326	1.5	1.3	984
Wills Creek	[2] 810	4.5	4.0	7,527
Wakatomika Creek	[2] 235	5.0	4.5	2,457
Walhonding River	[3] 200	2.5	2.2	1,022
Muskingum River	[4] 207	5.0	4.5	2,164
	[5] 1,878			14,573

[1] Dennison to Coshocton.
[2] Entire watershed.
[3] Walhonding to Coshocton.
[4] Coshocton to Zanesville.
[5] At Zanesville.

18. A table showing the damages caused by the flood of March, 1913, is given below:

TABLE VI.

Stream and locality.	County and municipal bridges and roads.	Railroads and other public utilities.	Private property.	Works to improve navigation.	Total.	Lives lost.
Muskingum River:						
Marietta	$140,000	$125,000	$700,000	$14,500	$979,500	....
Devols	10,000	15,000	4,000	4,500	33,500	....
Lowell	140,000	45,000	46,000	8,500	239,500	....
Beverly	95,000	40,000	37,000	9,000	181,000	....
Luke Chute	6,000	10,000	16,000	8,500	40,500	....
Stockport	85,000	10,000	10,000	7,000	112,000	....
McConnelsville	125,000	35,000	170,000	14,000	344,000	....
Eagleport	20,000	25,000	35,000	8,000	88,000	....
Philo	110,000	20,000	60,000	12,000	202,000	....
Zanesville	250,000	800,000	2,100,000	15,000	3,165,000	2
Ellis	20,000	90,000	20,000	11,000	141,000	....
Dresden	120,000	72,000	35,000	....	227,000	....
Coshocton	170,000	325,000	50,000	....	545,000	4
Licking River:						
Newark	26,000	8,000	18,000	....	52,000	....
Wills Creek:						
Cambridge	7,000	5,000	5,500	....	17,500	....
Tuscarawas River:						
Newcomerstown	15,000	10,000	21,000	....	46,000	....
Port Washington	5,000	2,000	6,000	....	13,000	....
Tuscarawas	6,000	3,000	9,000	....	18,000	....
Dennison	4,000	12,000	7,000	....	23,000	....
New Philadelphia	65,000	35,000	25,000	....	125,000	....
Canal Dover	40,000	42,000	32,000	....	114,000	....
Zoar	8,000	34,000	4,000	....	46,000	....
Bolivar	5,000	....	6,000	....	11,000	....
Navarre	18,000	20,000	10,000	....	48,000	....
Massillon	65,000	50,000	55,000	....	170,000	....
Canal Fulton	38,000	20,000	25,000	....	83,000	....
Clinton	16,000	10,000	18,000	....	44,000	....
Sandy Creek:						
Canton	45,000	35,000	22,000	....	102,000	....
Conotton Creek:						
Mineral City	5,000	10,000	3,000	....	18,000	....
Walhonding River:						
Warsaw	80,000	90,000	35,000	....	205,000	....
Walhonding	80,000	95,000	25,000	....	200,000	....
Killbuck Creek:						
Millersburg	39,500	40,000	25,000	....	104,500	....
Holmesville	15,000	10,000	18,000	....	43,000	....
Wooster	40,000	150,000	45,000	....	235,000	....
Creston	8,000	10,000	14,000	....	32,000	....
Kokosing River:						
Mount Vernon	50,000	75,000	65,000	....	190,000	....
Fredericktown	25,000	22,000	15,000	....	62,000	....
Mohican River:						
Brinkhaven	22,000	52,000	36,000	....	110,000	3
Lake Fork:						
Ashland	56,000	18,000	15,000	....	89,000	....
Black Fork:						
Loudonville	60,000	33,000	26,000	....	119,000	....
Mansfield	107,000	215,000	50,000	....	372,000	2
Total	2,241,500	2,718,000	3,918,500	112,000	8,990,000	11

19. The foregoing table gives the damages directly attributed to this flood, but in addition this flood caused indirect damages through suspension of business, depreciation of property value, unsanitary conditions resulting from the flood, etc., which would probably equal and possibly exceed the direct damages sustained.

20. Local conditions, such as obstruction to the flow at high water by bridges, buildings, etc., intensified the damage at certain localities.

21. A total of 18 bridges (13 highway and 5 railroad) were destroyed on the Muskingum River alone; on the Walhonding and its tributaries 38 bridges were destroyed; and on the Tuscarawas River 13 bridges were wrecked or badly damaged.

22. Private property loss, exclusive of the loss of fertile lands by erosion or deposition of sand thereon, amounted to about $4,000,000; the damage to highway bridges and roads controlled by the 12 counties in the drainage area most seriously affected by the flood is estimated at nearly $2,300,000, and for railroads and other public utilities within the same area the amount was not less than $2,600,000. No previous flood losses in this watershed approach these figures.

23. The damage incurred by navigation in the flood of March, 1913, consisted in the physical damage to works of navigation and the indirect damages due to interference with navigation during the flood and until the more serious damages to the works of improvement could be repaired.

24. On the Ohio the flood from the Muskingum increased flood heights and contributed its share to the damage to navigation on that stream which was caused by this flood.

25. The damage to navigation on the Ohio was small, however, as no unusual damages were incurred by works of navigation and interference with navigation due to high water was unimportant. Considering the relatively small commerce on the Muskingum and the correspondingly small indirect damages to navigation caused by the flood of March, 1913, and the large indirect damages to other interests, it may be concluded that the ratio of the direct damages to navigation on the Muskingum River, to the direct damages to all interests, or $112,000 to $8,990,000, was about 1.3 per cent, but this may be larger in a future flood.

26. The effect of floods on the Muskingum River on floods on the Ohio River, in the vicinity of the mouth of the former stream, is fairly well shown by the following comparative statement of gauge heights at Wheeling, W. Va., Zanesville, Ohio, and Marietta, Ohio, during the highest stages of important floods in the Ohio Valley.

27. The gauge heights at Wheeling, W. Va., indicate the volume of the flood from the upper Ohio, while the gauge heights at Marietta, Ohio, at the junction of the Ohio and Muskingum, indicate the volume of the flood as a result of the combination of the flood from the Muskingum with that from the upper Ohio, though those include the increased height due to backwater from the inflow of the Muskingum.

28. The gauge heights at Zanesville indicate the volume of flood in the Muskingum.

29. In this statement floods of approximately equal volume from the upper Ohio, as determined by approximately equal gauge heights, have been grouped together, to permit of ready comparison of the effect of their combination with floods of varying volume from the Muskingum.

Flood.	Gauge heights at—		
	Wheeling, W. Va. (danger stage, 36 feet).	Zanesville, Ohio (danger stage, 25 feet).	Marietta, Ohio (danger stage, 25 feet).
January, 1895	36.2	17.6	36.6
March, 1910	37.8	32.6	40.9
March, 1905	42.3	24.5	40.5
February, 1908	42.8	24.4	40.6
April, 1860	43.0	33.1	44.0
March, 1902	43.3	16.0	39.3
January, 1904	44.2	26.9	41.7
January, 1913	44.6	25.6	42.7
March, 1898	44.6	36.8	48.0
February, 1891	44.9	27.3	44.0
March, 1907	50.1	31.9	50.5
March, 1913	51.1	51.8	58.3
February, 1884	52.4	34.0	52.9

30. Examination of the foregoing comparative statement seems to warrant the conclusion that for great Ohio River floods like those of 1884, 1907, and 1913, a reduction in flood heights at Marietta, Ohio, of at least 1 foot could be expected for each 3 feet reduction at Zanesville, Ohio, in stages that exceed the danger stage or 25 feet on the Zanesville gauge. If, therefore, the stage at Zanesville during the flood of March, 1913, had not exceeded 34 feet it can reasonably be asserted that the maximum stage at Marietta during this flood would have been about 52 feet, or some 6 feet less than the recorded maximum.

31. In the Muskingum watershed the characteristics of the stream valleys do not permit the general use of levees as a means of flood protection, and local storage by means of reservoirs would have to be resorted to. Reservoirs of the storage type, by reason of greater capacity required, the flooding of lands within the reservoir for long periods, and resulting increased cost, with no compensating advantages, are at first sight not justified on this stream.

32. Reservoirs of the dry or detention type appear preferable, but while these in the normal case would be used as such, it is believed that study should be given to having the outlets capable of control so that the discharge therefrom may be regulated for short periods when conditions warrant, in order to avoid combination of floods from the various tributaries of the Muskingum or of a flood in the Muskingum with one in the Ohio, as far as possible.

33. Investigation discloses the following possible sites for detention reservoirs on the Muskingum watershed, and these are indicated on the accompanying map:

TUSCARAWAS RIVER AND TRIBUTARIES.

Stream and dam site.	Height of dam.	Length of dam.	Capacity of reservoir.	Drainage area above.	Approximate area flooded in reservoir.
	Feet.	*Feet.*	*Million cubic feet.*	*Square miles.*	*Square miles.*
Tuscarawas River, 5 miles above mouth of Sugar Creek	35	1,056	5,800	1,273	11.8
Stillwater Creek, 11 miles above mouth	50	2,000	2,500	200	3.5
Conotton Creek, 1½ miles above mouth	40	2,600	1,680	190	3.0
Sandy Creek, 4 miles above mouth	70	3,170	4,900	535	4.8
Chippewa Creek, 1½ miles above mouth	26	2,690	1,012	116	2.8
Sugar Creek, 5 miles above mouth	60	2,500	3,900	280	4.6
Total			19,792		30.5

WALHONDING RIVER AND TRIBUTARIES.

Stream and dam site.	Height of dam.	Length of dam.	Capacity of reservoir.	Drainage area above.	Approximate area flooded in reservoir.
	Feet.	*Feet.*	*Million cubic feet.*	*Square miles.*	*Square miles.*
Killbuck Creek, 10½ miles above mouth	50	2,700	6,300	590	9.0
Killbuck Creek, 2 miles north of Wooster, Ohio	40	2,640	1,120	100	2.0
Mohican River, 1 mile above mouth	90	1,300	12,600	980	10.0
Mohican River, Lake Fork, 1 mile above mouth	40	800	5,600	342	10.0
Mohican River, Black Fork, 2 miles above mouth	50	800	9,450	585	12.5
Kokosing River, 2½ miles above mouth	80	2,100	3,696	470	3.3
Total			38,766		46.8

MUSKINGUM RIVER AND TRIBUTARIES.

Wills Creek, 8 miles above mouth	40	1,600	4,000	790	7.2

34. From the foregoing it would appear that had these reservoirs been in existence and properly regulated the total run-off during the period of the flood of March, 1913, might have been reduced by their aggregate capacity, or 62,558 million cubic feet, with the possible exception of the reservoirs on the Mohican River, Lake and Black Forks, where the aggregate capacity of the three reservoirs is 27,650 million cubic feet and the estimated run-off was only 21,384 million cubic feet.

35. As the drainage area above the dam site on the Mohican River is about 15 per cent of the drainage area of the Muskingum above Zanesville, it can be assumed that in addition to the 21,384 million cubic feet run-off from the watershed of the Mohican River, Lake and Black Forks, from the rainfall of March 23–27, 1913, there also ran off from these drainage areas 15 per cent of the 7,200 million cubic feet normal discharge during the same period, or 1,080 million cubic feet.

36. The total storage in these three reservoirs could be assumed, therefore, as 22,464 million cubic feet, and the total storage in all the reservoirs as 57,372 million cubic feet.

37. The storage of 57,372 million cubic feet would reduce the total discharge during the flood period at Zanesville and the mouth of the river to 58,020 and 69,216 million cubic feet, respectively.

38. The effect of this reduction in discharge on gauge heights at Zanesville is difficult of accurate determination, but it may be roughly approximated by assuming that the ratio of the maximum discharge for a 12-hour period with reduced total discharge to the maximum discharge for a 12-hour period during the March, 1913, flood is the same as the ratio of the reduced total discharge to the total discharge in that flood, or $\frac{58020}{108192}$=about 53 per cent.

39. The maximum discharge at Zanesville for a 12-hour period, as shown by Table III, was 12,960 million cubic feet, and 53 per cent of this is 6,869 million cubic feet, which corresponds to a discharge of about 159,000 second-feet, or about 41.5 feet on the Zanesville gauge.

40. The Licking River, by reason of its steep slope and relatively small drainage area, discharges quite rapidly, and, as its watershed is in the western part of the Muskingum watershed, the run-off from the storm of March, 1913, which moved from west to east, had practically all been discharged past Zanesville by the time the crest from the upper tributaries reached this point.

41. If we disregard the 9,796 million cubic feet from the Licking, the resulting reduced total discharge and total discharge past Zanesville becomes 48,224 and 98,396 million cubic feet, respectively.

42. Applying the same reasoning as above, the maximum discharge would be about 147,000 second-feet, corresponding to a gauge height of about 39 feet.

43. The worst flood on record in the Muskingum prior to March, 1913, was that of March, 1898, and for the 12 days from March 20 to March 31, 1898, inclusive, it is estimated that about 57,600 million cubic feet was discharged past Zanesville, which is practically equal to what the reduced discharge in the flood of March, 1913, would have been past that point had the reservoirs been in operation.

44. The crest of the flood of March, 1898, reached a height of 36.8 feet on the Zanesville gauge.

45. It would appear from the foregoing that, with reservoirs of the capacities given above, the flood of March, 1913, at Zanesville could have been reduced to a height something in excess of the crest of the March, 1898, flood. Whether a greater reduction is practicable or whether the reduction, combined with channel improvements, levees, and raising of grades, would give complete protection, can be determined only by studies based on careful surveys. It is believed that these studies should be undertaken.

WABASH RIVER.

46. The Wabash River drains portions of three States—Ohio, Indiana, and Illinois—with drainage areas as follows: In Ohio, 400 square miles; in Indiana, 23,800 square miles; and in Illinois, 8,800 square miles; or a total of 33,000 square miles, an area nearly as large as the State of Indiana, whose area is 35,910 square miles. Approximately two-thirds of the State of Indiana is drained by this stream.

47. The river and its tributaries lie almost wholly within the area of glacial drift, and they are, therefore, comparatively new streams from a geological point of view, and flow in channels that are as yet unstable and unformed, with generally low banks. The drainage basin is in general comparatively flat, highly cultivated, and thickly settled. The only timber standing exists as groves or wood lots and along the edges of the streams. The mean annual rainfall is about 40 inches. Winter conditions vary from rather severe in the northern portion of the basin to moderate in the southern portion.

48. The length of the Wabash River is about 517 miles. The elevation of the sources of the river is about 1,000 feet, while mean low water at the mouth is 315 feet above tide, making a total fall of 685 feet, or an average of 1.3 feet per mile. The fall, however, is far from uniform, being much greater in the upper portion than in the lower. The following table shows the average fall per mile for various sections of the river:

TABLE I.

Location.	Distance from source.	Elevation above tide.	Average fall per mile.
	Miles.	*Feet.*	*Feet.*
Source	0	1,000	
Huntington	100	600	3.0
LaFayette	205	506	1.8
Covington	250	470	.8
Terre Haute	303	447	.4
Vincennes	389	398	.6
Mount Carmel	422	373	.8
Mouth	517	315	.6

49. An estimated area of 160 square miles at the headwaters of the Wabash is drained into Grand Reservoir. This reservoir, which has a capacity of about 4 billion cubic feet, was used formerly to store water to feed the Erie & Miami Canal, but at present is maintained as a lake, and is claimed by some to be a source of danger to both the Wabash and Miami Valleys, who fear its containing banks may break and increase the flood in either valley by the amount of water stored in the reservoir. From Grand Reservoir to Huntington, a distance of 100 miles, the valley has been formed chiefly by the present stream and is a shallow and narrow trench with an average fall of 3 feet per mile. At Huntington the river enters the old outlet of Lake Maumee, a glacial lake that occupied part of the basin of Lake Erie. This outlet has a valley several times as large as that of the Wabash above this point. From Huntington to Covington, a distance of 150 miles, the average fall is 1.5 feet per mile. There are several rapids in this portion of the river. Between Covington and Terre Haute, a distance of 53 miles, the fall is only 0.4 foot per mile, this being the lowest gradient, for so long a section, found on the river. From Terre Haute to the mouth, a distance of 214.4 miles, the average width of the flood plain is about 4 miles, varying from 1 mile, a short distance below Terre Haute, to 8 miles, below Vincennes.

50. The important towns situated on the main stream, with their population and distances from the headwaters, are given below:

TABLE II.

Miles from source.	Name of town.	Population 1910.	Miles from source.	Name of town.	Population 1910.
65	Bluffton	4,987	250	Covington	2,0[illegible]
85	Markle	820	264	Cayuga	911
100	Huntington	10,272	280	Clinton	6,229
120	Wabash	8,687	303	Terre Haute	58,157
135	Peru	10,910	345	Hutsonville	722
155	Logansport	19,050	389	Vincennes	14,895
185	Delphi	2,161	422	Mount Carmel	6,934
205	LaFayette	20,081	452	Grayville	1,940
230	Attica	3,335	465	New Harmony	1,229

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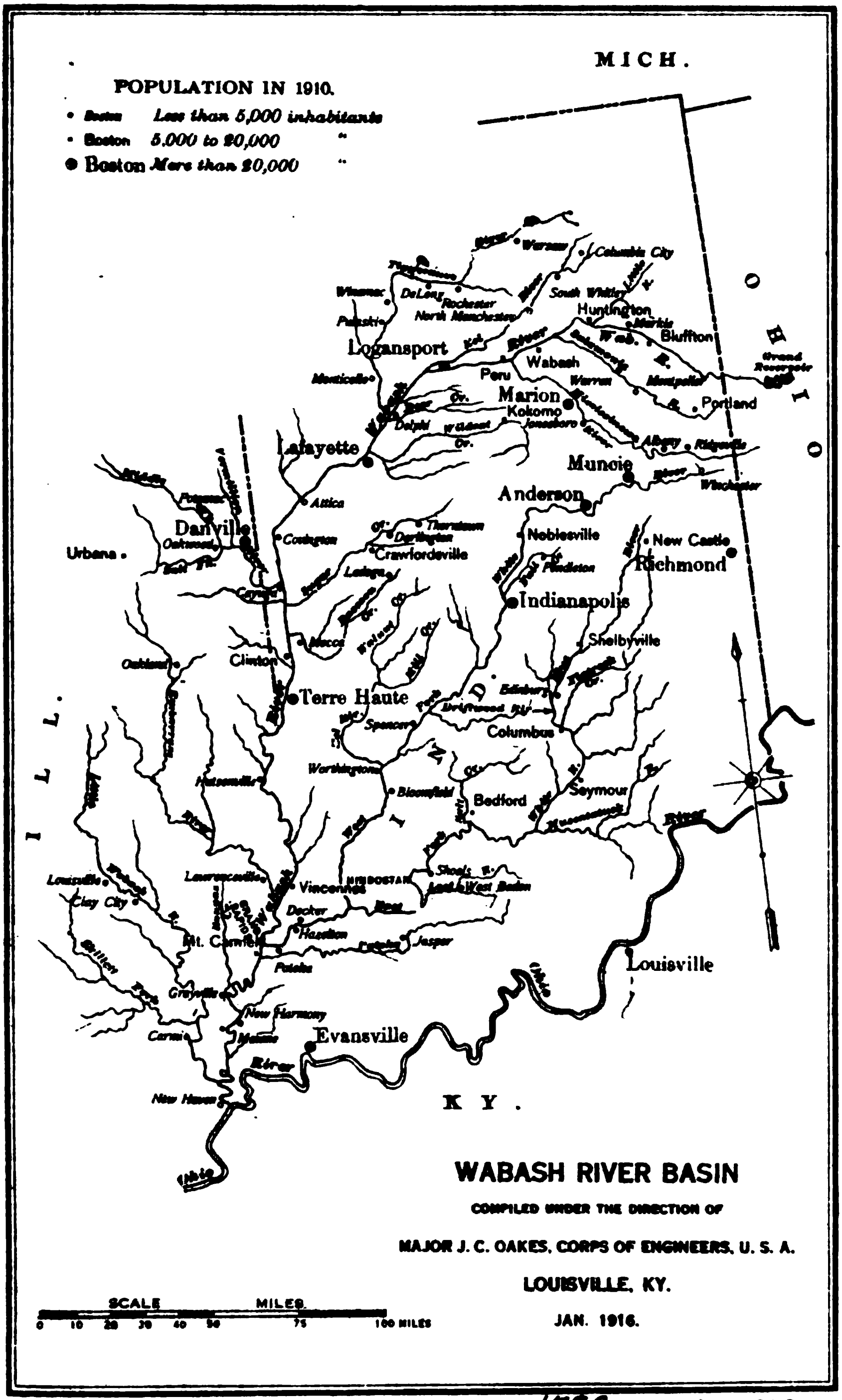

WABASH RIVER BASIN

COMPILED UNDER THE DIRECTION OF

MAJOR J. C. OAKES, CORPS OF ENGINEERS, U. S. A.

LOUISVILLE, KY.

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51. The important tributaries, with their lengths and drainage areas, beginning at the source, are given in the following table:

TABLE III.

Miles from source.	Name.	Bank.	Length.	Drainage area.
			Miles.	*Sq. miles.*
100	Little River	Right	25	320
114	Salamonic River	Left	75	540
135	Mississinewa River	..do	100	830
155	Eel River	Right	110	860
186	Deer Creek	Left	45	300
197	Tippecanoe River	Right	166	1,780
203	Wildcat Creek	Left	67	870
263	Vermillion River	Right	50	[1] 1,350
	Middle Fork		50	(430)
	Salt Fork		45	(480)
272	Sugar Creek	Left	70	830
280	Raccoon Creek	..do	65	530
395	Embarrass River	Right	140	2,380
421	White River	Left	50	[1] 11,410
	West Fork[2]		310	[1] (5,330)
	Fall Creek		60	(250)
	Eel River		110	[1] (1,110)
	Mill Creek		45	(290)
	East Fork		280	[1] 5,860
	Flatrock Creek		90	(500)
	Salt Creek		60	(650)
	Muscatatuck River		80	(1,110)
	Lost River		50	(360)
422	Patoka River	Left	100	860
452	Bonpas Creek	Right	35	280
502	Little Wabash River	..do	200	[1] 3,320
	Skillett Fork		100	(1,040)

[1] Includes drainage area of tributaries.

[2] Includes Driftwood and Blue Rivers.

52. The principal tributary, draining one-third of the whole basin, is the White River, which is formed by two streams, known as East Fork and West Fork. These streams drain the south-central portion of Indiana. The Little Wabash is second in size, with the Embarrass next and then the Vermillion, all draining the eastern part of Illinois. The other tributaries, with the exception of the Tippecanoe, are small, most of them draining less than 1,000 square miles each.

53. The Salamonie River, which has its source in Jay County, Ind., near the Ohio State line, at an altitude of about 1,000 feet above tide, flows in a generally northwesterly direction for a distance of 75 miles and empties into the Wabash River some 6 miles above Wabash, Ind. The elevation at the mouth is about 667 feet above tide. The descent from Portland to Montpelier, a distance of 25 miles, is less rapid than in the remaining 40 miles, being 3 feet per mile for the upper portion and 4 feet per mile for the lower. The principal towns, with distances in miles from the source and their populations in 1910, are: Portland, mile 10, 5,130; Montpelier, mile 35, 2,786; and Warren, mile 50, 1,189.

54. The Mississinewa River has its source in Ohio about 10 miles east of the Indiana State line at an altitude of about 1,100 feet above tide. The flow is in a westerly direction into Indiana, and this course continues for some 30 miles, at which point it turns northwest and flows parallel to the Salamonie for the greater part of the distance to its mouth near, Peru, Ind. The length of the river is about 100

miles and the total fall about 467 feet. The principal towns, with distances in miles from the source, and their populations in 1910, are: Ridgeville, mile 25, 1,302; Albany, mile 37, 1,289; Jonesboro, mile 69, 1,573; and Marion, the largest, mile 75, 19,359.

55. The following extracts are taken from the 1911 report of the State geologist of Indiana:

> It is a very crooked stream and has no large tributaries. * * * The width (of the valley) is variable. Broad bottoms are succeeded by gorges and narrows. The limestone gorges which occur in northern Grant County are the most picturesque in Indiana, and the bottom land is not surpassed by bottom land anywhere. The basin is long and narrow. * * * No natural storage occurs in this basin, since the land has been systematically drained and the forests removed. The absence of wooded land in this basin is particularly noticeable. This is due to the gas boom, at which time the forests were practically all destroyed, because it was thought that there would be no wood needed for fuel in the future. Before the land was artificially drained there was considerable natural storage caused by the irregular relief of the glacial drift. This did not take the form of lakes, nor even swamps, but was poorly drained land. This land is now perfectly drained by tile.

56. The Eel River, which enters the Wabash from the northeast at Logansport, rises about 10 miles north of Fort Wayne. At the headwaters are many small lakes. The valley is of recent geological formation and has little bottom land. The bluffs are from 60 to 70 feet in height. The drainage basin is long and narrow, the length of the river being about 110 miles and the area of the basin being 860 square miles. The tributaries are short, and those that do not rise in lakes are intermittent streams. The total fall is about 326 feet. The slope, however, is not uniform, as can be seen by reference to the approximate figures in the following table:

Profile of Eel River.

Location.	Distance in miles from source.	Average fall in feet per mile.
Source	0	0
Columbia City	19	2.3
Collemar	34	4.9
Liberty Mills	44	2.4
North Manchester	50	6.3
Eel River R. R. Bridge in Miami County	70	2.1
Mouth at Logansport	110	2.6

57. The most important towns, with distances in miles from the source and their populations in 1910, are: Columbia City, mile 19, 3,448; South Whitley, mile 31, 1,176; and North Manchester, mile 50, 2,428.

58. The following is an extract from the annual report of the department of geology and natural resources of Indiana for 1911 relative to power development on this river. A detailed description of both present and possible sites is also given in that report:

> There are eight developed power sites on Eel River and six intervening points where power could be conveniently developed. The developed sites are at North Manchester, Laketon, Roann, Chile, Mexico, and two in Logansport. The undeveloped sites are between North Manchester and Laketon, between Roann and Chile, and Chile and Mexico, between Mexico and Adamsboro, and two between Adamsboro and Logansport.

59. The Tippecanoe River, the main northern tributary of the Wabash, has its sources in northeastern Indiana, about 35 miles west of the Ohio State line and about 30 miles south of the Michigan line. It has a length of about 166 miles and an estimated fall of 426 feet. From its source to Ora, a distance of 82 miles, it flows in a generally westerly direction and then turns south, entering the Wabash some 9 miles above La Fayette. The basin, as far down as Ora, contains innumerable small lakes and marshes. The greater part of the fall in upper portion is made in the short sections that connect these lakes or marshes. From Rochester to Monticello, a distance of 80 miles, the fall is about 2 feet per mile, and in the remaining portion is nearly 3 feet per mile. The principal towns, with distances and populations, as noted in previous descriptions, are: Warsaw, mile 22, 4,430; Rochester, mile 57, 3,364; Winamac, mile 98, 1,607; Monticello, mile 137, 2,168.

60. The State geologist of Indiana has investigated the power sites along this river, and the following paragraph is taken from his annual report for 1911:

> The Tippecanoe is without doubt the best power stream in Indiana except the St. Joseph. Its minimum discharge is greater than that of either fork of the White River or of the Wabash at Cicott Street Bridge, in Logansport, which is below the mouth of Eel River. The broad valley flats along the Wabash and White Rivers are also distinct disadvantages when compared to the Tippecanoe, which has high banks and little bottom land, except in the last 10 miles of its course. That part of the Tippecanoe which lies between Winamac and the mouth is the part which is well adapted for power development. In spite of the advantages for power development, there are but two developed sites on the entire stream below Delong. These sites are at Pulaski and Monticello. The development of power above Pulaski is not feasible. The current in this part of the stream is sluggish but steady. There are no ponds, and the bed of the stream is composed of pure white sand, which is extremely beautiful under the water. There are no bowlders and no bedrock. There is little timber drift in this part of the stream, and on the whole it is a stream ideally adapted to pleasure trips.

61. *Wild Cat Creek.*—The next tributary of importance is Wild Cat Creek, which has its sources about 20 miles east of Kokomo, Ind., a town whose population in 1910 was 17,010. The general direction of the stream is to the west. Its length is 67 miles, and its drainage area 870 square miles. Practically the entire area drained by this creek lies to the south, as the stream flows within a few miles of the northern border of its basin for the greater part of its length.

62. The Vermilion River, which, with its tributaries, has a drainage area of 1,350 square miles, enters the Wabash some 12 miles below Covington, Ind. Except in the lower 10 miles and a narrow strip along the eastern edge of the basin, this river and its main tributaries, Middle and Salt Forks, which have about the same drainage area as the Vermilion proper, lie within the State of Illinois. The principal towns, beginning at the source, with their populations in 1910, are: Potomac, Ill., 764; Oakwood, Ill., 1,159; Danville, Ill., 27,871; and Cayuga, Ind., 911.

63. Sugar Creek rises in central Indiana and flows in a generally southwesterly direction, emptying into the Wabash about 9 miles below the Vermilion. It has a length of about 70 miles and a drainage area of 830 square miles. The principal towns are Thorntown, Darlington, and Crawfordsville, whose respective populations in 1910 were 1,508, 780, and 9,371.

64. The following description and profile of Sugar Creek is taken from the annual report of the Indiana State geologist:

> It is a very rapid stream, and abundant power is available when there is sufficient water. * * * The valley of Sugar Creek is narrow, and little bottom land occurs. * * * When the extreme irregularity of discharge of this stream is considered it is plain that the power is not feasible for continuous use. Not only is the low discharge a menace, but also the stages are dangerous. Sugar Creek is very wild during high water because of the narrow valley through which it flows. * * * The profile of the stream was determined and is given in the following table:

Location.	Distance.	Altitude.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
Source	0	1,000	....
Bluff Mill	60	565	7.25
Pleasantview	5	543	4.4
Narrows	8	502	5.12
Mouth	13	450	3.31

65. Raccoon Creek also rises in central Indiana, and enters the Wabash about 7 miles below Sugar Creek. Its length is 65 miles, and its drainage area is 530 square miles. The general direction of the valley is to the west or southwest. The principal towns are Ladoga, with a population of 1,148, and Mecca, with a population of 1,350.

66. *Embarrass River.*—Of the four tributaries between Wild Cat Creek and White River, the Embarrass River is by far the largest, being in length and drainage area the third largest tributary of the Wabash. The length of the Embarrass is 140 miles, and its drainage area, which is entirely within the State of Illinois, is 2,380 square miles. Its sources are near Urbana, Ill., and its junction with the Wabash is some 5 miles below Vincennes, Ind. The largest towns with their populations in 1910 are: Oakland, 1,159, and Lawrenceville, 3,235.

67. White River is the chief tributary of the Wabash, and drains about one-third the entire Wabash Basin. The White River proper has a length of but 50 miles, extending from the confluence of the East and West Forks to its junction with the Wabash at Mount Carmel. The altitude at the forks is about 400 feet above tide, and the elevation of mean low water at the mouth is 374.4 feet. The average fall per mile is, therefore, about 0.5 feet. The largest towns are: Hazleton, with a population of 648, and Decker, near by, with a population of 560. The two forks of the White River are about equal in both length and drainage area.

68. The West Fork of the White River rises in eastern Indiana, a few miles west of the Ohio State line and flows westward for a distance of 75 miles, at which point it turns and takes a southwest course to its mouth. The descent from its source, which has an altitude of 1,175 feet, to Anderson, a distance of about 60 miles, is very rapid, being about 8 feet per mile for the first 15 miles, about 6 feet per mile for the next 25 miles, and about 5 feet per mile for the remaining distance. The fall for the 50 miles between Anderson and Indianapolis is about 2.5 feet per mile. Below Indianapolis, for about 30 miles, the fall exceeds 3 feet per mile, and from this point to the mouth is about 1.5 feet per mile. The two important

tributaries are Fall Creek, an eastern tributary, entering just above Indianapolis, and Eel River, entering at Worthington.

69. Fall Creek drains an area of 250 square miles, has a length of 60 miles, and a total fall of some 300 feet. The fall in the upper 20 miles is about 7.5 feet per mile, and in the lower 40, nearly 4 feet per mile. The stream derives its name from a cascade about 10 feet in height at Pendleton.

70. Eel River drains an area of 1,110 square miles and has a length of 110 miles. Its two most important tributaries are known as Mill Creek, entering from the east, with a length of 45 miles and a drainage area of 290 square miles, and Walnut Creek, with a length of some 50 miles and a comparatively small drainage area. This river should not be confused with the river of the same name entering the Wabash near Logansport.

71. The principal towns along the West Fork, with their populations in 1910, are: Winchester, 4,266; Muncie, 24,005; Anderson, 22,476; Noblesville, 5,073; Indianapolis, 233,650; Spencer, 2,150; Worthington, 1,732; Bloomfield, 2,069; and Pendleton, on Fall Creek, 1,293.

72. The East Fork of the White River rises northwest of Newcastle, Ind. The flow is in a generally southwesterly direction to a point some 15 miles north of Columbus. This portion of the stream is known as Blue River. From this point the flow is south to Columbus, the head of the East Fork proper, and bears the name of Driftwood River. The length of the East Fork, including Blue and Driftwood Rivers, is about 280 miles. The portion of the stream known as Blue and Driftwood Rivers has a length of about 100 miles and an average fall of 5 feet per mile. From Columbus to the mouth of the Muscatatuck a distance of 55 miles, the average fall is nearly 1.7 feet per mile. In the remaining 125 miles the fall is slightly more than 0.8 feet per mile. In this lower portion of the stream are occasional ripples and rapids in which a descent of several feet is made within a mile. The most conspicuous of the rapids is at Hindostan, where a fall of 5 feet occurs. The principal towns along the river, with their populations in 1910, are: Newcastle, 9,446; Shelbyville, 9,500; Edinburg, 2,040; Columbus, 8,813; Seymour, 6,305; Shoals, 1,015; Bedford, on Salt Creek, 8,716; and West Baden, on Lost River, 746. The four largest tributaries are Flatrock and Salt Creeks, Muscatatuck and Lost Rivers.

73. Flatrock Creek, like Blue River, has its sources a few miles northeast of Newcastle, Ind. The length of this creek is about 90 miles, the drainage area about 500 square miles, and the average fall per mile from its source to its mouth, at Columbus, is about 5 feet.

74. The Muscatatuck River empties into the East Fork about 55 miles below Columbus. This stream has a length of 80 miles. The descent in the 25 miles above the mouth is comparatively small, the gradient being the same as the lowest on the Wabash, which is from Covington to Terre Haute 0.4 foot per mile.

75. Salt Creek, the next large tributary enters the East Fork from the north about 90 miles below Columbus. It has a length of about 60 miles, a drainage area of 650 square miles, and a fall of about 3 feet per mile.

76. Lost River, so named because it flows in a subterranean passage for several miles, enters the East Fork from the east at a point some 35 miles above its mouth. The length of this stream is about 50 miles, and the area of its basin is about 360 square miles. The subterranean passage in times of freshet is not sufficiently large to accommodate the water, and it then flows on the surface in its former bed, which is now covered with a heavy forest.

77. The Patoka River enters the Wabash scarcely more than a mile below the mouth of White River. The length of this river is about 100 miles, the drainage area about 860 square miles, and the total fall some 425 feet. The drainage system is made up of three small systems, which were formerly distinct and discharged northwesterly into the White and East White Rivers. The principal towns are Jasper, with a population in 1910 of 2,196, and Patoka, whose population is 657.

78. The Little Wabash River, in length and drainage area, is the second largest tributary. Its length is about 200 miles, and the drainage area, which lies entirely within the State of Illinois, is 3,320 square miles. The river rises in the southwestern corner of Coles County and flows in a southerly direction to Louisville. From Louisville to the mouth the general direction is southeastwardly. The descent on this stream is much more gradual than on most of the other tributaries. From Louisville to Carmi, a distance of 115 miles, the average fall is about 0.7 foot per mile, and in the lower 30 miles, from Carmi to the mouth, is slightly less. The principal towns on the Little Wabash, with their populations in 1910, are: Louisville, 950; Clay City, 950; Carmi, 2,939; and New Haven, 425.

79. Skillett Fork enters the Little Wabash about 5 miles above Carmi, and is the largest tributary, having about one-third the total drainage area. The length of the stream is about 100 miles. From the Baltimore & Ohio Railroad crossing, about 90 miles above the mouth, the fall is about 1.6 feet per mile for the first 45 miles and about 0.5 foot per mile for the remaining distance.

80. Much information about the Wabash River has been printed in official documents, as follows, all relating to questions of navigation only:

Report of Chief of Engineers, 1871, page 485: Improvement of river as far as La Fayette by removal of bars and obstructions.

Report of Chief of Engineers, 1872, page 472: Description of obstructions and estimate for their removal as far as Lafayette.

Report of Chief of Engineers, 1885, page 1649: Examination, Logansport to Delphi. Not considered worthy of improvement.

Report of Chief of Engineers, 1891, page 2411: Examination, Terre Haute to La Fayette. Not considered worthy of improvement.

Report of Chief of Engineers, 1904, page 2726: Examination, Vincennes to Perryville. Section of river under improvement since 1882. Considered as not desirable to continue the improvement.

Report of Chief of Engineers, 1904, page 2729: Survey from Vincennes to mouth of river. Not advisable at that time to undertake improvement of river.

House Document No. 246, Sixty-first Congress, second session: Examination, Mount Carmel to mouth of river. Not advisable to improve river at that time.

None of the foregoing reports contain maps.

House Document 1001, Sixty-third Congress, second session: Survey from Terre Haute to mouth of river; 13 charts, 64 sheets; improvement considered not warranted at that time.

It will be noted that in none of these examinations or surveys has been considered the question of floods and flood protection.

81. *Works of improvement.*—For a number of years appropriations were made by the United States and work for improving this stream was carried on. At the time the work was begun the river was badly obstructed by bars, accumulations of snags, rocky reefs, and numerous secondary channels or cut-offs. Navigation was impracticable except at high stages of water. A lock and dam had been built at Grand Rapids by the Wabash Navigation Co., and a few improvements had been made at other places also by private enterprise, but, as none of them was of a substantial character, they rapidly deteriorated and became useless.

82. The original project and outline of improvements proposed is found in the report of Maj. G. Weitzel, Corps of Engineers, January 4, 1872, page 472, Annual Report of the Chief of Engineers for 1872. The first appropriation was made by Congress June 10, 1872. This project proposed the improvement of the river from its mouth to La Fayette, Ind., by special works at 12 designated localities, the construction of a new lock and dam at Grand Rapids, and the general work of snagging and dredging. Work at various places other than those mentioned in the project was added from time to time, but no general revision of the original estimate was made.

83. The river and harbor act of March 3, 1881, made separate appropriations for work above Vincennes and for work below Vincennes, thus dividing the original project, and subsequent to that date funds were provided separately for each section. Work was carried on as follows:

84. *Below Vincennes.*—Subsequent to 1881 work was continued under the original project, but the estimates were modified from time to time, as necessity therefor arose, as in the cases of the dam for closing the New Harmony cut-off, the lock and dam at Grand Rapids, etc. Levee work at Grayville, Ill., was added in 1887, and completed, as proposed, at a cost of $25,000. In 1898 a plan and estimate, amounting to $50,000, for additional work at New Harmony was approved, but at the same time it was urged that if the improvement of the river was to be continued the old project should be abrogated, a comprehensive survey of the river made, and a new project formulated, based upon data furnished by the survey and of sufficient scope to meet existing needs of commerce. The survey was authorized and funds therefor provided by the river and harbor act of June 13, 1902. The report of the survey, proposed plan for improvement, estimate of cost, and action taken in connection therewith, may be found on page 2729, Annual Report of the Chief of Engineers for 1904.

85. The expenditures to March 31, 1881, amounted to $317,845.44, in addition to the $7,000 paid to extinguish the franchise of the Wabash Navigation Co. and acquire their property; $25,000 for the levee work at Grayville, from 1887 to 1892; and $365,111.76 for other work since 1881 on this part of the river, or an aggregate of $714,957.20 for work below Vincennes.

86. Previous to 1885 a fairly good channel for boats having a draft not exceeding 2½ to 3 feet was maintained, but as the river and harbor act of July 5, 1884, made specific appropriation for a lock and dam at Grand Rapids, near Mount Carmel, Ill., the suspension of operations elsewhere became necessary, in view of the fact that the funds available since that date were not sufficient to

complete the lock and dam and at the same time maintain the former works for bank protection and to concentrate the water flow and clear the channel of obstructions. Consequently the work formerly done deteriorated rapidly, the structures being destroyed by ice and high water or rendered useless by the water cutting its way around them. The channels, cut through rock reefs and shoal places, became choked with snags, stumps, and bowlders, thus leaving the river without any permanent improvement excepting that resulting from the lock and dam at Grand Rapids. Through navigation at low water became impracticable. Boats drawing 20 inches could pass from Mount Carmel to Vincennes —a river distance of about 34 miles—at all stages, but could reach Mount Carmel, 94.7 miles from the mouth of the river, only when the gauge at the lock read 7.5 feet or more, on account of the obstruction due to the cut-off at New Harmony.

87. *Above Vincennes.*—There was no change in the original project for work above Vincennes, and a small amount of money was expended for a number of years on this stretch of the river without materially improving conditions. The expenditures amounted to a total of $95,254.87.

88. Appropriations for the improvement of the Wabash ceased in 1902. Since that date the lock and dam at Grand Rapids have been operated and maintained by annual allotments from the indefinite appropriation for "Operating and care of canals and other works of navigation," act of July 5, 1884, as amended by act of March 3, 1909.

89. The total expenditure by the Government on improvements and operating and care of lock to June 30, 1913, is as follows:

Below Vincennes	$714,957.20
Above Vincennes	95,254.87
Total	810,212.07
Operating and care of lock	82,332.95
Total for river	892,545.02

As a result of this expenditure nothing remains to-day except the lock and dam at Grand Rapids and a number of cuts through rock bars, which produced no beneficial result.

90. *Flood-protection works.*—No general project for flood control in the Wabash River basin has been made, nor have the necessary data been obtained for any such project. Many attempts have been made to protect individual communities and properties, principally by the construction of levees.

91. Between Terre Haute and the mouth of the river, a distance of 214 miles, 87 miles of the levees have been built, of which 49 miles are on the left bank and 38 miles on the right bank. Above Terre Haute there are undoubtedly other levees, but no definite information about them is at hand.

92. Practically all of the levees below Terre Haute are improperly placed and constructed, and, while they protect the land behind them during ordinary flood, in many cases they were the cause of great damage during the flood of March–April, 1913.

93. There is no general authority, either State or National, to prevent the improper location of protection works, such as these levees,

unless it can be shown that the construction of the works affect navigation adversely.

94. The Federal Government has expended no money for flood protection in the Wabash Basin.

95. *Commerce.*—Before the construction of the existing excellent system of railroads, considerable commerce was developed on the Wabash River. In 1880 this amounted to a total of about 115,000 tons annually on that part of the river between Covington and Vincennes, with smaller amounts on other sections.

96. This commerce, however, gradually decreased until at the present time little exists. The diminution is shown by the following official record at the Grand Rapids Lock, opened to traffic in 1894:

Fiscal year.	Steamboats.	Barges and flats.	Rafts.	Miscellaneous.	Total.	Commerce.
						Short tons.
1897	60	80	27	130	297	3,749
1898	46	76	31	199	352	2,374
1899	45	53	32	118	248	2,417
1900	49	53	36	100	238	6,419
1901	62	68	25	112	267	2,364
1902	48	45	14	171	278	2,448
1903	91	82	10	114	297	2,747
1904	139	53	38	249	479	4,370
1905	220	90	45	1,042	1,397	8,025
1906	514	265	13	1,346	2,138	3,990
1907	576	197	28	1,085	1,886	6,600
1908	538	280	8	871	1,607	5,155
1909	527	204	22	741	1,494	5,121
1910	103	80	....	108	291	1,075
1911	723	116	2	550	1,391	2,063
1912	739	106	1	385	1,231	2,010
1913	655	96	1	264	1,016	1,187
1913[1]	452	65	1	193	721	1,252
1914	295	24	....	170	489	187

[1] Calendar year.

97. During high-water stages of the Wabash and Ohio Rivers there is still carried out of the Wabash from the country adjacent to the lower 50 miles of its length a small but unknown tonnage of cereals and other agricultural products, but there appears to be no prospect of an increasing commerce, and there will be none until the river is improved for navigation purposes. No operations for this purpose are carried on at the present except the maintenance and operation of the lock and dam at Grand Rapids.

98. A thorough and radical treatment of the river as a whole will be necessary before any commerce thereon may be expected, and the question of improvement for navigation purposes is directly and intimately interwoven with the problem of flood control, because of the low banks, flat adjacent country, improperly placed levees, and the importance of reducing if possible the flood discharge of the river.

99. *Floods in the Wabash Basin.*—Serious floods in this basin were recorded in 1847, 1857, 1866, 1875, 1883, 1897, 1904, 1908, 1910, and 1913 (two, January and March). In addition there have been many minor floods, and during each year there are a number of days during which the stream overflows its banks. Based upon the limited records in this office, the average number of days that the Wabash is

out of its banks at Terre Haute is 15; at Vincennes, is 23; and at Mount Carmel, is 15.

100. A careful survey of the Wabash River below Terre Haute was made by the Engineer Department, United States Army, and completed just before the March-April, 1913, flood occurred. Shortly after the water subsided a surveyor was sent out to determine the high-water elevations along the section of the river surveyed. The records at a few points are as follows:

Distance from mouth.	Locality.	Elevation, zero of gauge.	Gauge reading.				Range of stage.
			Mean low water.	Mean stage.	Bank-full stage.	High water 1913.	
Miles.							
214.4	Terre Haute, Ind	447.11	0.00	3.2	16.0	31.20	31.2
190.0	Darwin, Ill	431.55	.80	5.4	15.0	27.30	26.5
162.0	Riverton, Ind	415.90	1.20	5.3	14.0	26.80	25.6
127.8	Vincennes, Ind	397.66	.46	4.2	14.0	24.00	23.6
118.5	Above St. Francisville	391.00	1.50	5.3	13.0	23.60	22.1
94.5	Mount Carmel, Ill	372.63	.73	6.3	19.0	30.42	29.7
63.3	Below Grayville, Ill	357.88	.00	6.1	17.0	29.37	29.4
30.7	Below Maunie, Ill	340.63	.70	6.5	14.0	32.87	32.2
0.0	Mouth (Ohio)[1]	314.90	.00	16.9	25.0	54.85	54.9

[1] There is no gauge at the mouth, but the values given are taken above mean low water, which is assumed as the zero of a tentative gauge, and were derived from the Ohio River stages.

101. The Rivers and Lakes Commission, State of Illinois, have made an investigation and report on the prevention of overflow of the Little Wabash and Skillett Fork Rivers, and the Illinois State Geological Survey has made report and plans for reclamation of lands subject to overflow in the Embarrass River Valley, Bulletin No. 25.

102. The following gaging stations are maintained by the United States Geological Survey: Mount Carmel, Oakland, Ste. Marie, Clay City, Golden Gate Corner, Wayne City, and Mills City, in Illinois, and Shoals, Ind. The following stations were maintained at one time, but have been abandoned: Logansport, La Fayette, Terre Haute, Delphi, Indianapolis, and Cataract.

103. The following stations have been established by the Indiana Geological Department: Logansport, Cataract, Peoria, Maysville, Tannsbull Bridge, and Taylorsville, in Indiana.

104. The following stations are maintained by the Engineer Department, United States Army: Terre Haute, Vincennes, and Grand Rapids, Ind., and Maunie, Ill.

105. A few high-water marks of flood of 1875 for the White River were made of record. (See Report, Chief of Engineers, 1896, pp. 2491–2492.)

106. In the early days before the country was thickly settled, before the bridges, railroad embankments, and other structures were built across the stream or on the flood plain, the ordinary high waters and moderate floods did not do much damage. In recent years, however, encroachments on the channel and the flood plain by cities, villages, railroads, levees, etc., have contracted the waterway, and each flood or high water does considerable damage. The country adjacent to the stream and its tributaries is highly cultivated, and each time a high water occurs during the season when the

crops are growing or being harvested, large agricultural loss results. These losses have led to attempts by communities and individuals to protect certain sections by the construction of levees, and a large number of isolated and detached levees have been constructed, principally along the main stream and the forks of the White River. Between Terre Haute and the mouth of the Wabash there are more than 87 miles of levees already constructed. These levees are almost invariably improperly placed. The owner of property who first begins the construction of a levee naturally places it on the edge of the stream. If the owner of property on the other side of the river wishes to protect his property, he builds a levee also on the edge of the stream, thus obstructing the passage of flood waters and increasing local flood heights. This causes, during the first great flood, a breach or breaches in one or both levees, resulting in great loss to the parties or communities concerned.

107. *Levees.*—There are 87 miles of levees along the section of the river surveyed, of which 49 miles are on the left bank and 38 miles on the right. These levees are from 6 to 10 feet wide on top, from 15 to 25 feet across the base, and vary in height from 8 to 16 feet, and they are usually close to the bank of the stream. Very little attention has been paid to their maintenance, and crevasses caused by high water have left many broken stretches. They have been built to a height above the ordinary high water, but the flood of 1913 overtopped these levees in many places. There are no levees below Grayville, Ill.

108. A table giving the extent of these levees and their mileage is given below, which well illustrates the piecemeal and haphazard method of their construction:

Miles from mouth.		Length of stretch.[1]		Miles from mouth.		Length of stretch.[1]	
From mile—	To mile—	Right bank.	Left bank.	From mile—	To mile—	Right bank.	Left bank.
214.8	213.6	1.2	....	....	....	4.9	24.2
213.4	212.2	1.2	....	167.5	166.7	.8	....
212.6	212.3	....	0.3	166.7	163.4	3.3	....
212.8	211.9	.4	....	162.0	159.5	....	2.5
211.9	211.3	....	.6	156.3	152.0	....	4.3
211.2	210.3	....	.9	143.3	130.3	13.0	....
209.1	207.1	....	2.0	142.6	136.0	....	6.6
203.2	199.6	....	3.6	129.4	123.2	6.2	....
199.5	191.8	....	7.7	127.5	118.1	....	9.4
192.8	192.6	.2	....	97.5	97.2	....	.3
180.0	179.5	....	.5	88.8	86.5	2.3	....
178.3	169.7	....	8.6	84.9	84.1	.8	....
176.9	176.7	.2	....	79.3	77.4	1.9	....
173.7	173.5	.2	....	77.0	76.6	.4	....
171.8	171.5	.3	....	76.2	75.7	....	.5
169.6	169.4	.2	....	72.5	67.9	4.6	....
168.6	167.6	1.0	....	67.4	66.4	....	1.0
		4.9	24.2			38.2 48.8	48.8
						87.0	

[1] Miles.

109. A study of the gauge heights at Mount Carmel seems to indicate that high water is more frequent of late years than formerly. This increase in frequency can be possibly explained as due in part to a periodicity of great precipitation, the present being a period of

supposed maximum precipitation, and also in part by the fact that throughout the drainage basin the lands have been drained, and all natural detaining reservoirs emptied and drained, large areas of land that were formerly swamps having been cleared and drained by ditches and tile, and further by the construction of levees which have destroyed some of the natural storage area for high waters along the river valley. The result is that there is undoubtedly an increase in the rapidity with which the general run-off occurs, and owing to encroachments on the stream the flow of the water is obstructed at points, resulting in higher stages locally and ultimately the destruction of the encroachments, followed by loss and damage below them in the rush of the released waters.

110. The greatest flood recorded in this section of the country is that of March–April, 1913, and it has been estimated by the Indiana Flood Commission that $25,000,000 damages occurred in Indiana. This estimate applies only to the tangible losses, and does not include losses due to the suspension of business, decreased confidence in the security of investments, and other intangible losses.

111. During March 20–21, a storm of moderate intensity occurred accompanied by a precipitation of about ½-inch over the whole Ohio River Basin. This precipitation saturated the ground so that when the great storm occurred, March 23–28, a very large percentage of the precipitation ran off into the streams. During the five days in question there was a precipitation of 6 inches over the whole area drained by the Wabash with 8 inches over a wide belt in general prolongation of the East Fork of the White River reaching a maximum of 11.5 inches at Richmond near the Ohio state line. It is not an exaggeration to say that every town located within the limits of the flood plain of the river and its tributaries was affected. Great damage was also done to bridges, culverts, highway and railroad embankments, levees, and all other obstructions to the rapid run-off of the storm waters.

112. Prof. W. K. Hatt, chief engineer of the Indiana Flood Commission, has published the following partial determination of losses in Indiana due to the flood of 1913:

Part of damages sustained in Indiana in the flood of March, 1913.

1. County highways and bridges	$2,825,240
2. Railroads—steam	5,299,810
3. Electric railways	788,000
4. Buildings and personal property	8,104,250
5. Telephone and telegraph	200,000
6. Crops	735,700
7. Live stock	149,380
8. Farm lands (part of White River only)	247,500
9. Suspension of business	582,000
Total	18,931,880

Counties not included in (1): Cass, Floyd, Clinton, Miami, Fayette, Sullivan.

Railroads not included in (2): Central Indiana R. R., Chicago & Wabash R. R., Cincinnati, Hamilton & Dayton R. R., Toledo, Peoria & Western R. R., Toledo, St. Louis & Western R. R.

Electric lines not included in (3): Marion & Bluffton Traction Co., Bluffton, Geneva & Celina Traction Co., Central Indiana Lighting Co., Indianapolis Street Ry. Co., Louisville & Northern Ry. & Light Co., Vincennes Traction Co., Washington Street Ry. Co,

(5) Includes Indianapolis Telephone Co. and Central Union Telephone Co.

Counties in flood districts not included in (4), (6), (7), and (9): Adams, Blackford, Cass, Clark, Clay, Perry, Putnam, Randolph, Ripley, Clinton, Fayette, Floyd, Fountain, Franklin, Scott, Sullivan, Switzerland, Tippecanoe, Gibson, Grant, Greene, Harrison, Howard, Vanderburg, Vermilion, Vigo, Wabash, Huntington, Jay, Jefferson, Ohio, Parke, Warrick, Wells, White, Whitley.

(8) Includes loss only in 230 miles of East and West Forks of the White River, through Morgan, Owen, Greene, Daviess, Knox, Jackson, Lawrence, and Martin Counties.

113. Of the tributaries of the Ohio the Wabash is third in length, second in size of drainage basin, and second in discharge. It is the only large tributary not actually navigated at the present time. For years regulating works were built, snagging was carried on, and one lock with dam at Grand Rapids was constructed, but all operations have ceased except the maintenance and operation of the lock and dam. The river is practically not navigable at the present time because of obstructions, and only recently the question of the improvement of the stream between Terre Haute and its mouth received an adverse report on the ground that the expense would be too great in comparison with the resulting benefits.

114. The capacity of the stream for navigation purposes and future improvement is being constantly reduced by encroachments on the channel, by levees built too close to the banks, by the construction of bridges with extensive approach embankments and without movable spans, by city dumps, etc., all tending to cause caving banks, clogged channels, and increased height of floods. Nor is the damage alone to the Wabash, for these encroachments cause the flood waters to carry into the Ohio greater quantities of silt and débris. Again, the increase in rapidity of run-off causes quick rises which will affect very materially the operation of the dams now being constructed in the Ohio River.

115. A study of this stream for purposes of determining the feasibility of its improvement for navigation shows that below Terre Haute the flood plain varies in width from 1 to 10 miles; that the banks are extremely low, seldom more than 14 or 15 feet above low water; and that the channel capacity of the stream is extremely deficient, great floods overflowing the flood plain in places to depths of over 10 feet.

116. This study shows also that the improvement of the river by methods of channel regulation would be extremely difficult, if not impossible, with the certainty that the results of such improvement would be incommensurate with the cost. It would be impossible to use fixed dams, because such dams would cause more frequent overflows of the flood plain. Consequently, if the river is to be improved without considering the flood problem, the extremely costly method of improvement by movable dams will be necessary.

117. As far as the flood problem is concerned, the general type of river and the natural features of the river basin make it nearly certain that the method of flood protection to be adopted will be that by levees, channel improvements, and the removal of obstructions due to encroachments on the flood plain. Inasmuch as a large number of levees have already been built, it is probable that if sufficient information is obtained to allow such works to be properly designed and located and the control vested in the United States, the river

below Terre Haute might be completely leveed. It would probably be possible to combine the construction of the levees with channel enlargement, removal of obstructions, etc., and it might be possible to so locate and construct the levees that permanent dams of low lift might be used in the river instead of movable dams. It is possible that raising the grades of some communities might, upon careful study, be found to be the best and most economical method of flood protection of local application.

118. Concerning cooperation between the United States, the States, and communities within the States, the chairman of the Rivers and Lakes Commission of the State of Illinois, in speaking for that commission, has stated as follows:

> This commission, in behalf of the State of Illinois, will assign a representative of its engineering department to canvas the towns along the Illinois side of the Wabash River and collect such additional data and evidence bearing upon the height of floods and the effect of any obstructions and extent of overflow which has occurred in the past. It will review these data and endeavor to compile a flood profile of the Wabash together with hydrographs of the above-mentioned gauge records. With this data at hand the commission will endeavor to formulate and suggest remedial measures for flood control or overflow protection. On completion of the same the commission will be pleased to refer these data and conclusions to your office with the hope that similar matter may be collected to supplement this by your department, or by the State of Indiana to you, and the commission would then be glad to receive your comments, criticisms, or suggestions for relief measures.
>
> Whatever may be the means of financing relief measures, it will be necessary to have definite plans to submit to the proper authorities. We believe, however, that it will be found practical to finance such relief measures, as Illinois has been very liberal in doing her part in flood control, as shown by the legislative appropriations, work completed or now in progress by the State at Cairo, Mound City, and Shawneetown.

The State of Indiana has created a flood commission, from which body a similar cooperation may be expected if the legislature can be prevailed upon to furnish necessary funds. However, plans based on information gathered in the manner described above, and without a survey and comprehensive data as to run-off, discharge, etc., will naturally be more or less inaccurate, and the resulting projects will lack the definiteness necessary to insure confidence and support. It will be impossible to obtain an authoritative statement as to what extent the States and communities will cooperate with the United States until some one provides a definite project or projects, with estimates of cost, upon which judgment may be based as to the advisability and practicability of the projects.

119. A survey of the entire watershed of the Wabash would be a very expensive undertaking and is not justified by the interests involved at the present time, but as the works of flood protection will apparently consist mainly of levee construction it is believed that such data should be on hand to permit the question to be decided at any portion of the stream as to what the heights of the levees and their distance apart should be. This information can be obtained in sufficient detail at a reasonable expense, compared to the area involved, and it is believed that authority and funds for such survey should be obtained.

120. The board concludes, therefore, that the United States would not be warranted, in the interest of navigation alone at this time, in cooperating with the States and other communities and interests

in devising or carrying out plans for flood protection on the Wabash River, if other rivers were not also to be considered. As a part of a comprehensive scheme of flood restrictive measures on all of the important tributaries of the Ohio River, the possibilities of further study on this river is important. It is believed, while the preparation of projects for other tributaries of the Ohio River affording great benefits from flood-prevention works on these tributaries themselves as well as on the Ohio are undertaken, accurate field examinations, power studies, and more detailed estimates should be made and the stream-flow measurements now in progress continued in order that they may fit into any general scheme of flood prevention adopted for the other tributaries of the Ohio, and the Ohio itself.

121. The board finds that the benefit to navigation of flood protection is a difficult matter to determine from the data at hand upon the tributaries of the Ohio River, which stream is now being provided with a continuous system of locks and movable dams. While the United States might not be justified in the interests of navigation alone in cooperating with the States and other communities and interests in devising or carrying out plans for flood protection on a stream considered by itself alone, the effect of each important tributary of the Ohio River upon the operation of the Ohio River dams and the resulting navigation of that important water highway is such that data concerning the flow of each of these streams, and especially of the flood flow, should be determined. On these grounds the board believes that the question of preparation of plans and the extent of cooperation should be fully investigated.

122. The Federal Government, through the Weather Bureau and other agencies, is already engaged in the collection and publication of information and data which will not only be of great value in the final solution of the flood problem, but which now contribute materially in reducing the losses from floods by giving warnings of coming high waters, thus enabling property owners to undertake such rescue or preventive measures as time and circumstances permit. A further reduction in flood damage can, in the opinion of the board, be secured through the agency of the United States by the extension of the authority of the Federal Government so as to give it control over streams in the interest of flood protection, similar to that provided in the interest of navigation by the act approved March 3, 1899. Control over waterways in the interest of navigation has been limited to those channels susceptible of actual navigation and, to a certain extent, to an indeterminate area beyond, within which area control over the tributaries is necessary to the proper protection of navigation in the main channels. Control over waterways in the interest of flood protection must of necessity include practically the whole stream and its tributaries without any limitations imposed by any relationship to the interest of navigation.

123. The board, in prior reports, printed in House Documents No. 246, Sixty-third Congress, first session, and No. 914, Sixty-third Congress, second session, endeavored to point out the practical impossibility of a proper control of streams for the purpose of flood protection when the dividing line between control by the United States by reason of relationship to the interest of navigation and control by the several States by reason of their sovereignty is in-

capable of exact or even approximate determination. It there stated (par. 16, Doc. 246):

> The board has been much impressed in its examination by the evils of divided control of the watercourses. The obstructions which have been placed along the various streams ought never to have been put there and their construction should have been prevented, but since the control of rivers is in the twilight zone between the spheres of Federal and State authority it developed that what was anybody's business was nobody's business, and no effective authority has been exercised by anybody. These rivers are feeders of a navigable stream and have an important effect upon the regimen of the Ohio River, and it is the opinion of the board that the authority of the United States should be exercised to prevent encroachments upon them exactly as in the case of navigable streams. It is believed that this is the only method of control which promises good results in practice. The board further urges that immediate steps be taken to exercise such authority, since bridges and other structures are to be rebuilt at once and there is evident danger in several places that they may be rebuilt in an obstructive manner.

124. Control over our waterways for the purposes of flood prevention and protection must, in the opinion of the board, be delegated to one central authority before any rational plan for flood control can be devised, and compliance with such plan or other measures for the amelioration of flood conditions properly enforced. This central authority is logically and necessarily the Federal Government.

125. The board wishes to emphasize its opinion, however, that such control should preferably not be based on the uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that will accrue in the protection of life and property from loss and the interruption by floods of general interstate commerce and the interference with the mails.

126. No method of flood protection, even for a limited locality, should ever be adopted without a study of the effect of the proposed plan upon flood conditions in the stream both above and below the point where the contemplated changes are to be made. For it is evident that a plan considering only the local effect may have the result of increasing flood heights at other points. If the plan contemplates holding back the water at a certain point, the result can be secured only by damming it back at that point with consequent increase of height at localities immediately above. If it provides for an improved channel, or otherwise for increasing the rate of flow past the point, the result will be the pouring of more water in a given time upon the stream immediately below than it would otherwise have received, and a possible flooding of localities which might have escaped. No method changing the conditions at one point can be adopted without changing the conditions at other points, and care must be taken that while the beneficial effect is secured at one locality the results at the other localities affected are not unreasonably detrimental.

127. No method should be adopted without careful consideration and an accurate comparison between the value of the protection afforded on the one hand and the cost of the changes themselves combined with the damages to other localities on the other. A reservoir might be used to protect a community and the cost of the creating dam be reasonable, but the value of the land taken for the reservoir might make the cost of the remedy out of proportion to the trouble which it is intended to relieve. The building of levees may secure a community from high waters, but the increased flood

heights at other points will involve the building of new levees or the giving of additional height and strength to old levees at other places, unless the trouble is to be merely transferred. The cost of these new levees and the additions to the old ones thus becomes an item of the cost of protection which should receive consideration. Too often the plan of flood protection adopted by one community is that selected solely for its relatively small cost and without the cooperation of or consideration for other parts of the river.

128. A dam either for impounding the water or restraining the flow can not be utilized without flooding a tract above it, depending in area upon the height of the dam and the steepness of the ground. In very hilly or mountainous districts, as upon the tributaries of the Monongahela. the valleys will be deep and the reservoirs narrow and long, while the value of the land for agricultural purposes will probably be small per acre, although where there are coal mines or coal deposits the mineral value of the land may be large. Where the land is only moderately hilly or rolling, the dam will be less in height but the reservoirs will be much larger in area and shallower for a given capacity than in a mountainous region; the land will also probably be of higher value per acre, so that its cost will be high, if not excessive. It must also be remembered that the damage from floods is only occasional, in some instances even rare, but that the withdrawal of land for an impounding reservoir is immediate, continuous, and perpetual, while for a restraining reservoir its use is so modified and uncertain that its present and future value will be greatly impaired; thus a reservoir cost, which is in itself smaller than the money value of the protection it affords, may by its interest charges amount to much the larger sum in the course of a few years.

129. Most streams have low-lying lands along their course which are overflowed by the stream as soon as it rises beyond its banks. These lands, technically termed the flood plain, form a natural reservoir of greater or less capacity, depending upon their extent and the depth to which submerged.

130. Levees diminish the natural reservoir capacity of the stream. Where a flood overspreads the natural lowlands along a river the current across those overflowed lands is usually gentle compared with that in the stream channel unless some artificial obstruction, such as road embankments or fills for other purposes, so contract the waterway at some point as to cause a backing up of the water there. An overflow without strong current is seldom harmful to the land, and is not ordinarily objectionable unless it enters buildings or occurs when crops are in the ground. On the Ohio and its tributaries floods have usually occurred too early in the season to interfere materially with crops, while along the lower Mississippi, owing to the earlier season in the more southern latitude and to the later arrival of the flood waters at this part of their course, the overflows are apt to damage or destroy the season's crops. Levees by diminishing the natural reservoir capacity of the stream throw the waters into the lower river more quickly and to a greater height than would otherwise occur. Levees of insufficient height or without proper channel capacity between them are liable to fail or be overtopped in excessive floods, with the resulting damage to large areas of the land which they were intended to protect, for the suddenly loosed waters

either wash away the top soil or cover it with a layer of sand and gravel. A levee built by a community for the protection of one side of a river only is rarely placed with any regard to the width of the waterway requisite to carry the flood flow or to the interests of the property owners on the opposite bank unless the location is supervised by some competent authority. The board knows of one case where a drainage district recently built a levee along the banks of a river and so close to the stream that had the people on the opposite side built one similarly situated the area of the channel left between the two levees would have had a capacity sufficient for only one-fifth of the water carried in freshets occurring every few years. There is no method of flood protection requiring more intelligent supervision than the proper establishment of levees and there is none for which one authority having jurisdiction throughout the length of the stream is so greatly needed to secure safe results, not only to protect one community against another but at times to keep a community from damaging itself, for an improperly placed or poorly built levee is certain to do one or both.

131. In those States which have a regularly organized commission or other body legally empowered to supervise plans for flood protection and to veto improper projects or hastily considered plans, something can be done to prevent one community from injuring another, but in many States the people on one portion of a river have but little or no redress against the work detrimental to them which may be undertaken by the people upon another portion. Even where such a commission exists it is in many respects powerless to prevent constructions which are recognized as inadvisable and known to be dangerous. An instance which was recently brought to the attention of this board was that of the commissioners of a county building a bridge across a stream within the limits of a certain city. For economical reasons the bridge was made as short as possible and did not provide sufficient space underneath for the heavier floods to which the stream is liable. The city endeavored to prevent the building of the bridge and attempted to secure the adoption of some other plan which would not interfere with the high-water flow, but was unsuccessful. The stream was not one regarded as ordinarily navigable and appeal was not made to the War Department. It is doubtful if any State authority exists in most States to prescribe the amount of opening which must be left for the passage of flood waters at any bridge or in a railroad or highway embankment across the bottom lands adjacent to a river, or to prescribe the height of such embankment provided the proper openings are not made. Only Congress can exercise controlling authority where the questions arise between parts of a stream in different States.

132. It is probable that the Federal Government has control over conditions affecting floods in streams upon other grounds than the resulting influence upon navigation, although Congress has as yet not seen fit to exercise such control of nonnavigable rivers upon these other grounds. The flood of 1913 throughout the States of Ohio, Indiana, and Illinois interfered with mail communication and obstructed commerce between the States. The damage which this flood caused would have been lessened and the interruption of commerce

and of the transmission of the mails would have been less serious and of shorter duration had there been some supervision and control of the embankments and fills which had been made at will in the flood plains of the streams and of the encroachments which had been made upon the stream channels. The same results occur in other floods and upon other rivers throughout the country, and as long as there is no authority to supervise constructions along the stream and one to enforce a reasonable regulation, the interruptions of commerce and mail carriage will continue. That an excessive erosion upon a tributary which is not navigable will eventually produce conditions in the main stream which is navigable is probable, but the result is remote and depends upon so many contingencies of irregular occurrence that the connection between any particular encroachment or inadequate construction and a shoaling in the main stream is too remote to permit an enforcement of proper conditions upon the theory of effect upon navigation.

133. The board has already expressed its opinion that the devising of plans for flood protection on the Muskingum and Wabash Rivers can not be undertaken without the accumulation of further data than is now in its possession, and that this data should be secured, but it regards it as of prime importance as a first step in proper flood protection that the War Department, which has in recent years endeavored to do all it could in the general interest of flood protection under existing laws, should have its hands further strengthened and supported by additional legislation. Congress has recently recognized the importance of this subject by creating a new committee upon flood protection, and this board recommends that the authority of the War Department, which now exists upon navigable waters, be extended so as to give it supervision over all structures and constructions hereafter placed upon nonnavigable streams which may unduly interfere with stream flow and increase flood heights and flood damages and interfere with interstate commerce.

134. To secure the data necessary for the preparation of flood-protection plans called for under the act and for the exercise of proper supervision, the board recommends surveys as indicated for each of the streams named herein.

Lansing H. Beach,
Colonel, Corps of Engineers, United States Army.
Edgar Jadwin,
Lieutenant Colonel, Corps of Engineers, United States Army.
T. H. Jackson,
Major, Corps of Engineers, United States Army.
P. S. Bond,
Major, Corps of Engineers, United States Army.
Geo. R. Spalding,
Major, Corps of Engineers, United States Army.
W. P. Stokey,
Major, Corps of Engineers, United States Army.
Robert R. Ralston,
Major, Corps of Engineers, United States Army.

[For Report of the Board of Engineers for Rivers and Harbors, see p. 6.]

PRELIMINARY EXAMINATION OF SCIOTO RIVER, OHIO.

War Department,
Office of the Division Engineer,
Central Division,
Cincinnati, Ohio, September 12, 1916.

From: The Ohio Valley Flood Board.
To: The Chief of Engineers, United States Army.
Subject: Report on preliminary examination of Scioto River, Ohio.

1. Pursuant to instructions contained in E. D. letter of December 14, 1915, the board of officers of the Corps of Engineers (constituted by S. O., No. 3, O. C. of E., 1913, as amended by subsequent orders) submits the following report on the preliminary examination of Scioto River, Ohio.

2. The board's report is practically the same as that furnished to the board by the district officer in charge of the first Cincinnati district at the date of its submission, to whom the duty of making the preliminary examination was assigned by E. D. letter of April 16, 1915.

3. This examination was authorized by the following item in the river and harbor act approved March 4, 1915:

> Sec. 15. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, and a sufficient sum to pay the cost thereof, as well as those included in section 14, may be allotted from the amount provided in this act: *Provided*, That allotments of such amounts as may be necessary may be made toward the completion of examinations and surveys heretofore authorized and for such other contingent expenses as are usually paid from the appropriation for "Examinations, surveys, and contingencies," to wit:
>
> * * * * * * *
>
> Scioto River and its tributaries, * * * in the State of Ohio; * * * with a view to devising plans for flood protection and determining the extent to which the United States should cooperate with the States and other communities and interests in carrying out such plans, its share being based upon the value of protection to navigation.

4. *Geography.*—(Pl. 1).[1] The Scioto is the chief drainage system of central southern Ohio. The drainage area is a rude rectangle about 50 miles wide in an east and west direction and 135 miles long in a north and south direction. The main drainage axis of the area is from north to south.

5. Near the center of the drainage area, but a little to the north and east, lies the city of Columbus, the capital of the State, a city of 181,511 inhabitants. At Columbus the upper Scioto and the Olentangy Rivers join to form the lower Scioto, which from that point flows almost directly south for 100 miles and enters the Ohio River at Portsmouth. About 40 miles north of Columbus lies the city of Marion, a manufacturing town of 18,232 inhabitants, and west of this city, a distance of 25 miles, is Kenton, a city of 7,185 population.

6. *Drainage system.*—The drainage system may be divided into three sections, in each of which the topography and conditions of drainage are quite distinct. From the western edge of the basin, through Kenton and Marion, and for 15 miles to the northeast of Marion, to the vicinity of Bucyrus, extends a belt of illy drained

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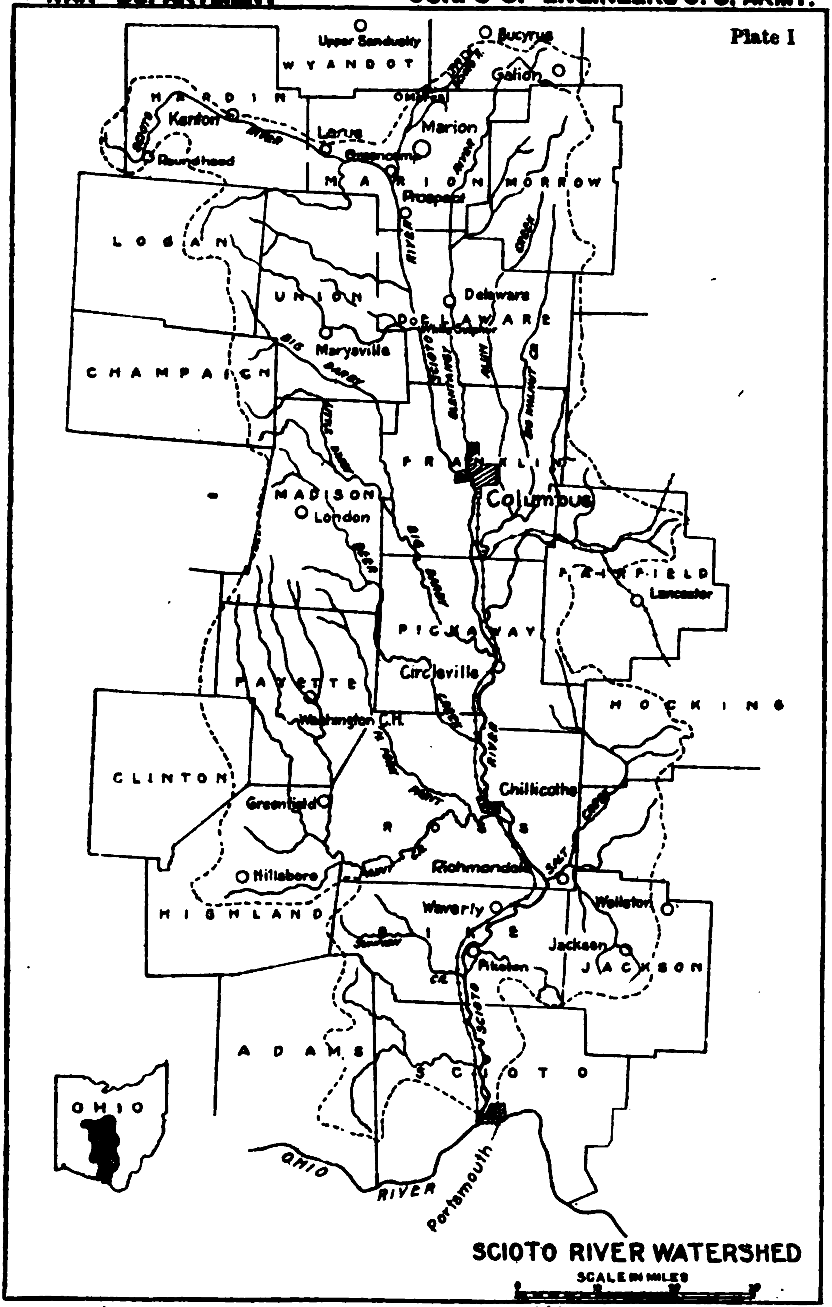
[1] Plate I only printed in this connection.

WAR DEPARTMENT **CORPS OF ENGINEERS U. S. ARMY.**

Plate I



SCIOTO RIVER WATERSHED

SCALE IN MILES

THE NORRIS PETERS CO., WASHINGTON, D. C.

House Doc. No. 1792; 64th Cong., 2d Sess.

land, occupying the flat divide between the waters of the Ohio River and those of Lake Erie. This may be called the summit section.

7. Between Marion and Columbus is what may be called the gorge section. Here we have a curious combination of nearly parallel branch streams, having long, narrow watersheds. Within a width of 16 miles are the Scioto River, the Olentangy River, Alum Creek, and Big Walnut Creek. In this section the Scioto River flows through a gorge with practically no flood plain. The Olentangy River flows through a somewhat wider valley, and its flood plain becomes in places as much as a quarter of a mile wide, though it is very narrow for the greater part of the distance. These two rivers join at Columbus, to form the lower Scioto. Alum Creek and Big Walnut Creek have flood plains somewhat similar to that of the Olentangy, narrow for the greater part, but widening here and there. These two creeks join their waters at a point about 5 miles to the southeast of Columbus, and thence flowing as one stream, the Big Walnut, enter the lower Scioto at a point about 10 miles south of Columbus.

8. Between Columbus and Portsmouth is the alluvial section. It is well described by the following quotation from "The Ohio Water Problem," by Prof. C. E. Sherman:

> It is the most striking valley in the State, extending between the hills like a level floor of rich black soil, almost uniformly 2 miles wide for a hundred miles, from Columbus to Portsmouth, where it terminates as suddenly as it begins.

The river in flood occupies the entire width of this valley, except where it may be excluded by levees.

9. *Previous reports.*—There have been no reports submitted on the improvement of the Scioto River for navigation purposes.

10. In 1896 a report was made by a board of engineer officers on the feasibility and advisability of improving and widening certain State canals between the Ohio River and Lake Erie or of securing satisfactory canals by new routes. Gen. (then captain) H. M. Chittenden made the surveys. The Scioto-Sandusky Valley route was one line considered. The report, which can be found in House Document No. 278, Fifty-fourth Congress, first session, was favorable as to the feasibility of all routes considered but unfavorable as to the advisability of undertaking the work, because—

> A canal 7 feet deep from Lake Erie to the Ohio, estimated to cost on the three routes, respectively, about $12,250,000, $18,000,000, and $23,000,000, would by inadequate depth both in the canal and in the Ohio (the radical improvement of the Ohio had not yet been undertaken) be so restricted in its benefits to interstate commerce its construction on any one of them is, in the opinion of the board, not advisable.

11. On the flood situation a report to the city of Columbus was made on September 15, 1913, by Alvord & Burdick, consulting engineers, Chicago, Ill. This report contains a careful study of flood conditions in the valley above Columbus and recommends that local relief to the city be secured by a cut-off within the city limits, combined with levees, at a total estimated cost of about $11,000,000.

12. A study of the flood problem in the Scioto Valley is contained in Bulletin No. 15, College of Engineering, Ohio State University, issued under the title of "The Ohio Water Problem," by Prof. C. E. Sherman. Prof. Sherman suggests that by means of certain storage reservoirs on the upper reaches of the Scioto and Sandusky Rivers,

connected by a summit-level cut, combined benefits for power, water supply, navigation, and flood protection might be secured.

13. The report of February 19, 1916, of Alvord & Burdick, chief engineers of the Franklin County conservancy district, on flood relief for the Scioto Valley is a very complete study of the entire problem. It carries recommendations for two detention reservoirs and certain channel improvements at an estimated cost of about $10,000,000, including relief for the city of Columbus, the cost to be distributed in accordance with the benefits, all in accordance with the terms of the Ohio conservancy act, passed February 6, 1914.

14. *Existing works.*—There have never been any works of improvement undertaken on this stream by the United States. When the Ohio canals were constructed by the State several dams were thrown across the river to divert water into the canal. The dam below Chillicothe thus became the head of navigation of the river.

15. Works which have been constructed for drainage and flood protection are described in connection with flood damages.

16. *Navigation.*—There is no present navigation on the Scioto, except a little local movement of sand, gravel, etc., at Columbus. In the early history of the State (as early as 1798) there was a large "keel-boat" navigation from Columbus downstream. In 1833, when the Ohio Canal was put into operation, the keel-boat traffic stopped. Steamboat navigation existed from 1824 to 1861, when the last steamboat, the *Piketown Belle*, was requisitioned by the United States for service elsewhere. Without radical improvement there is no prospect for future navigation.

17. *Floods.*—The general subject of floods in the valley, the damages done by them, and local protection measures will be discussed by section, in the order—summit section, gorge section, alluvial section. Damage to the city of Columbus and comprehensive plans for the relief of the entire valley will be discussed separately.

SUMMIT SECTION.

18. *Description.*—(Pl. II.) The main drainage lines of this section are the upper Scioto and the Little Scioto which flows into it at Greencamp. The upper Scioto gathers its headwaters in a basin-like depression known locally as "Round Prairie." The floor of this basin comprises some 8,000 acres of very rich, black soil.

19. Originally all of this land was swampy. Some 10 or 12 years ago, under the Ohio ditch law a drainage district was formed and a number of parallel ditches leading into the river were excavated. This system of drainage was sufficient to open a large part of the section to agriculture. The main stream, however, is inadequate both in slope and cross section to care for the water which is collected in the basin after heavy rains.

20. Leading out of Round Prairie, the river turns abruptly to the north and flowing through a narrow defile between two hills, which rise some 40 feet above the stream, enters what is locally known as the "Great Scioto Swamp." This area comprises some 18,000 acres of soil similar in fertility to that of Round Prairie. Here also a system of parallel ditches have been opened up and the river itself has been deepened and straightened. As in Round Prairie, however, the

drainage system is inadequate to prevent a flooding of this level area after severe storms.

21. Leaving the Great Scioto Swamp through a defile just west of the city of Kenton, the stream enters a very gently rolling country, through which it flows in a southeasterly direction for a distance of 30 miles to Greencamp. In this stretch of 30 miles no tributaries enter from the north, the river following very closely the southern edge of the slight ridge which forms the divide between the waters of the Ohio and those of Lake Erie.

22. From the south several small tributaries enter, and one considerable tributary, Rush Creek, with a drainage area of 113 square miles, enters a few miles east of the village of Larue. At Greencamp the Little Scioto, with a drainage area of 113 square miles, enters from the northeast, and the main river, having at this place a total drainage area of 526 square miles, enters the gorge section.

23. The stream just below Greencamp flows in a narrow defile between hills rising to 40 feet above the river, while along the Scioto and the Little Scioto above Greencamp and in the V of the two streams the elevation of the ground is considerably less than 20 feet above the stream bed.

24. In the 1913 flood an area of about 23,000 acres shaped somewhat like a shield with the point of the shield just below Greencamp and the horns reaching up the Scioto and Little Scioto, was flooded with water varying in depth from a few inches to 10 feet, the channel through the gorge being inadequate to carry off the waters.

25. *Summit section flood damages—Agricultural.*—It will be seen from the above that there are in all about 49,000 acres of land subject to flooding in this Summit section. These lands are very fertile. In Round Prairie and the Great Scioto Swamp the acreage is used for the most part for the raising of onions. In the "Shield," in the vicinity of Greencamp, the crops are more diversified. Only a few years ago the land in Round Prairie and the Great Scioto Swamp were still in swamp. That in the "Shield" near Greencamp was, however, being tilled. Later the drainage system of the upper swamps was constructed and it is not unnatural to believe, as do the farmers in the "Shield," that more water was poured into the already choked stream at Greencamp, resulting in the necessity for more ditching in the Little Scioto in that section, which work was done in 1911. Then came the heavy rains of the winter and spring of 1913, when in three days of March, 1913, upon an already saturated soil, something like 10 inches of rain fell; a total for the Summit section of approximately 280,000 acre-feet of water. Of this amount approximately 180,000 acre-feet was temporarily stored in the drainage area above Greencamp, a large part of it on the 49,000 acres of rich farming land above described, covering these lands to depths varying from a few inches to 10 feet. Coming in the spring of the year, this flooding did little damage to crops, though the slow run-off delayed spring plowing and planting. The flood did, however, break down the banks of the drainage systems and cause other damages, such as the flooding of farm houses and villages.

26. The heavy rains in this section of the country do not, however, always come in the winter or early spring.

> On July 15 and 16, 1915, * * * a heavy rain fell upon the headwaters of the Scioto * * * which caused far more loss to farmers than did the flood of March, 1913. The rainfall as taken from the United States Weather Bureau bulletin for July was as follows:
>
> | Station. | July 15. | July 16. |
> |---|---|---|
> | | *Inches.* | *Inches.* |
> | Kenton | 2.00 | 3.65 |
> | Marion | 1.20 | 3.05 |
> | Prospect | 1.90 | 3.08 |
>
> The summer of 1915 was one of the rainiest of record, keeping the ground well saturated until the above rain fell upon it. The result was a flood which destroyed about $2,000,000 worth of crops. The heaviest rainfall was along the upper Scioto headwaters and on Great Scioto Swamp (between Kenton and Lima). The crop loss was reported at more than $1,000,000 in the United States weather bulletin mentioned. The waters again flooded the area west of Marion (the "shield" near Greencamp) to nearly the height reached in March, 1913, but the flood loss to farmers in the affected area far exceeded that of 1913. * * * (The Ohio Water Problem, by Prof. C. E. Sherman, C. E.)

27. It is believed that a fair estimate of the damage done by this summer storm amounted to about $20 per acre for the 26,000 acres of the Round Prairie and Great Scioto Swamp section, and about $10 per acre for the 23,000 acres in the "shield," or amounting all told to about $730,000.

28. *Summit section flood damages, urban.*—Kenton, the county seat of Hardin County, had in 1910 a population of 7,300. The tax duplicate shows for the corporation a valuation of $7,603,730, including both personal and real property. The low parts of the town were flooded in the great flood of March, 1913, and to a lesser extent in July, 1915. The damage to property within the corporation in the flood of 1913 was about $50,000.

29. *Larue.*—Larue is a small village with a population of about 1,000. The taxable wealth is $788,620. The town was flooded in 1913, the flooded area including practically the entire village. While the property loss is known to have been small, no reliable estimate has been made.

30. *Greencamp.*—Greencamp has a population of about 300. Its taxable wealth is $297,760. Practically the entire town was under the flood waters of the 1913 flood. The damage was small and has not been estimated.

31. It will be noted that urban damage in the summit section is small. This is due to the fact that there are no excessive velocities, as slopes are very gentle. The damage caused is from high water, not current.

32. *Remedies, agricultural lands.*—The Ohio conservancy act, which was passed February 6, 1914, provides for the establishment of conservancy districts for the purpose of flood protection, drainage, irrigation, and reclamation of wet or overflowed lands, and empowers these districts to do everything that is necessary for the accomplishment of these purposes, including the borrowing of money, cooperating with other corporations, other conservancy districts, with the State government or that of other States or of the United States, etc.

33. Under this law the Upper Scioto drainage and conservancy district has been established. Preliminary funds have been fur-

nished by freeholders of Hardin County for the necessary surveys and for the preparation of the necessary plans. The limits of the district have not as yet been fixed, as they depend upon the provision of the law requiring that benefits to be had from the improvements proposed must exceed the assessments on the property concerned.

34. Mr. Arthur Morgan, chief engineer of the Miami conservancy district, has been employed as consulting engineer for the district, and the preliminary surveys are now being made. Property owners in Round Prairie have already petitioned that their lands be included in the district, and it is possible that the limits of the district will be extended to include these lands and also a part or all of those in the "Shield."

35. Until these or other surveys have been made and careful studies completed, it is difficult to say just what is the best solution of the flooding problem on the summit section. From preliminary studies based upon personal examinations made in the field by Capt. W. A. Johnson, Corps of Engineers, assisted by Mr. C. B. Harris, assistant engineer, and Mr. G. A. Loeb, junior engineer, and from data kindly furnished by Alvord and Burdick, and from the studies made by Prof. C. E. Sherman, Ohio State University, some of the difficulties involved in the solution may be brought out and some suggestions made as to the possibilities.

36. As stated above, something like 280,000 acre-feet of water fell upon the drainage area above Greencamp during the five days of heavy rains in March, 1913, and of this amount it has been computed from acreages and known elevations of the retained water that some 180,000 acre-feet were temporarily stored on the drainage area. Of the 7 inches which had fallen up to that time, fully 5½ inches remained on the area until after the crest of the great flood had passed Columbus. It was fortunate for the city of Columbus that the channels below Greencamp were not adequate to take care of the entire rainfall in this time. According to the studies made by Alvord and Burdick it is necessary to conclude that had the natural detention reservoirs existing in the summit section been destroyed by an adequate system of drainage before the 1913 flood, the flow through Columbus at the crest of the flood would have been increased by some 35,000 second-feet or from 140,000 second-feet to 175,000 second-feet.

37. Evidently, then, if channels are to be so radically improved as to carry off such a rainfall as that of March, 1913, either equally radical channel improvements must be continued all the way down the stream or artificial reservoirs to take the place of existing natural ones must be provided to store or temporarily detain the waters.

38. As a part of a more comprehensive plan which has been suggested by Prof. C. E. Sherman, a diversion of a portion of these flood waters into a reservoir on the Sandusky side might be secured. This would be accomplished by means of a summit-level cut leading from the vicinity of Greencamp northward across a low gap in the divide into the valley of the Little Sandusky River, where his summit-level reservoir "B" is to be located.

39. It will be seen that there is no simple, inexpensive solution to the flood problem, even in the small part of the entire Scioto water-

shed included in this summit section. Partial protection may be secured for the lands in Round Prairie and Great Scioto Swamp, through assessment on benefited land, by works which will tend to exclude from the flat lands all the waters which do not fall directly upon them, by the improvement of their channel outlets and the straightening of the very crooked stream between Kenton and Greencamp, but this work will only make more difficult the solution of the problem in the "Shield." It is not believed that the 23,000 acres of land in this latter area can afford at present to construct either an adequate channel outlet through the gorge (particularly as rock excavation would be necessary in the vicinity of Prospect) or the cut across the divide, and the consequent storage or detention reservoirs which would be needed if either course were pursued. It is possible, however, that in connection with some plan for water-power development on the Sandusky or in cooperation with conservancy districts on the Sandusky or lower Scioto, adequate drainage may some day be secured. These possibilities will be touched on later. It must not be forgotten, however, that the "Shield" is now an ideal natural detention basin. In 1913 there were temporarily held here some 126,000 acre-feet of flood waters. The area covered was about 23,000 acres, worth perhaps some $200 per acre. If this land were to be purchased outright for reservoir purposes, the cost per acre-foot of water detained would be about $36, and the land would be as useful for agriculture as it is now.

40. While local protection for the urban communities in this section is possible in all cases, the cost would probably be greater than the communities alone could bear. Such protection, if to be secured at all, must probably be obtained in connection with work of general improvement for the section.

GORGE SECTION.

41. (Pl. III.) For the 40 miles between Greencamp and Columbus the Scioto flows in a narrow valley having practically no flood plain. Damage in this section to agricultural lands was inconsiderable. The town of Prospect, 6 miles below Greencamp, was flooded in 1913. The highway bridge over the stream was destroyed. There was no loss of life in the town and no great damage, nor are there any artificial conditions which greatly affect flood heights. Local improvement by means of channel improvement or levees is possible, but if this is to be done it will undoubtedly be done in connection with the work for the protection of the "shield," as discussed above, or in cooperation with the Franklin County conservancy district, to be discussed later.

42. About 5 miles to the east of the Scioto the Olentangy flows through a somewhat similar valley. The damage to agricultural lands was greater in this section than on the Scioto, but not large enough to alone justify any considerable improvement. The city of Delaware (Pl. IV) is located on the Olentangy about 23 miles above Columbus. Its population is 9,400. It has a total taxable value of some $9,000,000.

43. Considerable damage was done here in 1913. Four city bridges were washed away, and the loss of life was reported as 19.

It was estimated that 250 houses were affected and 48 were washed away.

44. The damage was caused principally by rapid currents and the presence of obstructions consisting of buildings, etc., encroaching on the stream, a bridge and embankment of the Big Four Railroad below the town, three road bridges within the city and one highway bridge above the city. An embankment of the Pennsylvania Railroad runs parallel to the river on the side toward the city and performs the function of a levee, giving valuable protection to the tracks behind it.

45. All of the obstructive bridges were carried away by the flood. At the highway bridge above the town the pier on the right bank was undermined and destroyed and the superstructure carried away. The three highway bridges in the city not being fastened down were lifted from their abutments and wrecked. The most serious obstruction was the Big Four Railroad bridge below the city, which had a high embankment crossing the bottom lands on the left bank. This embankment developed a local head of 5 feet, as appears from actual levels taken of water marks above and below as soon as the flood subsided. The resulting current was sufficiently strong to carry portions of the heavy steel trusses of the bridge from 100 to 700 feet downstream. The bridge had three piers in a span of about 300 feet. The center pier was undermined and carried away with the two adjacent spans, the rest of the bridge remaining uninjured.

46. Several projects for local protection have been worked out for the city of Delaware. Those suggested by Prof. C. E. Sherman appear on Plate IV. They involve the expenditure of more than $250,000 and are intended to give adequate protection against such a flood as that of 1913 by channel enlargement, levees, etc. It is not probable that full protection can be secured at less cost than by the methods proposed in this report.

47. However, these projects were rejected as too expensive by the city officials, and a project by the county and city engineers involving the expenditure of $24,320 was adopted. The Olentangy through Delaware is to be treated as a county ditch under the law for that purpose. It is to be excavated to rock bottom for a width of 250 feet, which will give a depth of about 19 feet under the new bridges. This project will involve the removal of the Pennsylvania Railroad track from what was formerly the river bed. The consent of the railroad company for the removal has not been secured. The new bridges have been built with spans longer than those of the old bridges. The county engineer states that this scheme is not expected to give full protection against floods of the magnitude of that of 1913, but it would mitigate the damage very much, and it is within the means of the city. It is believed that the best solution of the Delaware problem is for that city and vicinity to be included within the limits of the Franklin County conservancy district, and thereby secure protection which will fit in with a comprehensive plan for the protection of the entire gorge section and the city of Columbus. On account of the magnitude of this plan and its bearing upon the entire valley it will be discussed after a description of conditions in the alluvial section below Columbus.

ALLUVIAL SECTION.

48. (Pls. V, VI, and VII.) At Columbus the upper Scioto River and the Olentangy unite to form the lower Scioto. The drainage area above Columbus is 1,614 square miles. The maximum flood rate at Columbus in the 1913 flood was about 140,000 second-feet, of which 80,000 second-feet came from the upper Scioto and 60,000 second-feet from the Olentangy. Between Columbus and Circleville, 25 miles below, Big Walnut (drainage are 555 square miles) and Little Walnut Creeks (drainage area 278 square miles) enter from the east; Darby Creek entering from the west with a drainage area of 554 square miles. At Circleville the total drainage area is 3,193 square miles, and the maximum rate of flood flow during the flood of 1913 was about 220,000 second-feet. Between Columbus and Circleville the flood plain varies from 3,000 feet in width at its narrow point to 3½ miles at Circleville, where Big Darby comes in.

49. Between Circleville and Chillicothe, about 45 miles below Columbus, no large tributary enters from the east. From the west Deer Creek enters with a drainage area of 409 square miles. The total drainage area at Chillicothe above the entrance of Paint Creek is 3,863 square miles and the maximum rate of flow during the 1913 flood was 260,000 second-feet. Just below the point for which this computation was made by Alvord and Burdick Paint Creek enters from the west. Paint Creek has a drainage area of 1,134 square miles, which is larger than that of the entire upper Scioto at Columbus. Usually flood damages at Chillicothe are ascribed to the outpouring of waters from this creek. In the 1913 flood, however, the damage is thought to have been due to the main river crest. The upper reaches of Paint Creek are very flat and natural storage comparable with that in the Summit section of the upper Scioto exists. The flood plain between Circleville and Chillicothe varies from 1 mile to 3½ miles in width.

50. The drainage area between Chillicothe and Portsmouth becomes narrower, the flood plain occupies nearly the entire valley, which is about 2 miles wide, and, except for this valley, the country is very rugged. Salt Creek, with a drainage area of 553 square miles, enters from the east. Sunfish Creek and Brush Creek come in from the west with a combined drainage area of 411 square miles. The total drainage area at Portsmouth is 6,481 square miles. The maximum rate of flow during the flood of 1913 has been estimated by comparative means to have been about 320,000 second-feet.

51. The slope of the main stream from Columbus to Portsmouth is about 2 feet per mile. The banks vary in height from 15 to 25 feet, the width between banks being from 200 feet to 350 feet.

52. *Flood damages, alluvial section—Agricultural.*—Writing in 1778 Mr. Thomas Hutchins, later chief geographer of the United States, says:

> The Scioto is a large gentle river bordered with rich flats or meadows. It overflows in the spring and then spreads out about half a mile, though when confined within its banks it is scarce a furlong wide. If it floods early it seldom returns within its banks in less than a month.

53. It is usually considered that the flooding of bottom lands in the spring of the year is rather beneficial than otherwise, the deposits having the effect of adding to or renewing the fertility of the soil.

This is true, providing the velocities of the flood waters are not such as to cause erosion nor the floods so great that the delay in running off prevents early plowing. Late spring floods and summer floods are, however, of rather frequent occurrence on the Scioto and to provide against these many small, detached levees had been built along the stream by the farmers, at their own expense, previous to the flood of 1913. These levees were entirely inadequate to protect the lands against the high waters of the flood of that year, and served merely to interfere with the spreading of the waters by temporarily damming them locally, thus greatly increasing the velocities and consequent destructive effects when they were finally overtopped or destroyed. In addition to the levees many of the roads and railroads in this valley crossed the flood plain on embankments. These served as dams for a short time and caused great local destruction when they finally failed or were overtopped. In some cases where these embankments had been built up to nearly the flood level they acted for a long time as detention dams, having inadequate sluices, and consequently flood heights above them were locally excessive.

54. The agricultural damage from the 1913 flood, as determined by Alvord and Burdick for the lower Scioto in Franklin, Pickaway, Ross, Pike, and Scioto Counties, is as follows:

Crops damaged or destroyed	$75,000
Loss of live stock	49,800
Lands totally ruined	303,800
Damage to partially ruined lands	515,900
Total direct loss	944,500

There were about 71,167 acres under flood, and Alvord and Burdick estimate that the depreciation due to this flood may be placed at $20 per acre, or in all $1,423,340, and if this be considered in the loss for purposes of considering the amount which the lands can pay for relief the total loss will amount to $2,367,900.

55. During the summer flood of 1915 it is estimated that the damage to crops along the lower Scioto amounted to $500,000.

56. *Urban damage, alluvial section.*—Except at Chillicothe, the direct damage to urban property in this section of the river, due to flood of 1913, was not large.

57. The city of Circleville is located on high land, and therefore was but slightly inundated. However, the indirect damage to this city, due to suspension of traffic on railroads and the inability of the waterworks and electric-lighting plants to operate, was considerable.

58. At Chillicothe (Pl. VIII) the loss was large, amounting in direct loss to nearly $1,000,000; 19 lives were lost, several houses were washed away, and severe erosion occurred in places, especially along Hickory Street. The indirect losses were also large. Interruption of shipping made it impossible for the large paper mill located at that city to ship its product at a time when there was great demand. The electric-light, waterworks, and street-car systems were unable to operate for two days.

59. The entire city lies immediately in the flood plain between the Scioto River and Paint Creek. In moderate floods the embankment of the Baltimore & Ohio Railroad had served as a levee to protect the town from inundation from the Scioto side, and most of the flood difficulties had been due to Paint Creek. During the 1913 flood,

however, the embankments of the Norfolk & Western Railroad and the Scioto Valley traction line across the flood plain and the collection of drift on the substructures of the bridges of these lines at the river caused a damming up of the flood until the Baltimore & Ohio embankment was overtopped and failed, the rushing waters passing down Hickory Street.

60. *Remedies, alluvial section.*—The elevation of the flood waters in the alluvial section varied from 15 to 25 feet above the banks of the stream. If levees are to be considered for the purpose of keeping the waters of a flood the size of that of 1913 within safe limits, they would of necessity have to be much higher than the elevation of the 1913 flood waters (Pl. IX); but levees no higher than the waters of 1913 would cost from $8,000 to $25,000 per linear mile for a levee on one side of the stream only, and in most localities they would be needed on both sides of the stream, requiring an assessment of from $12 to $36 per acre of land protected. These figures are, of course, only very rough guesses, based upon the very low unit price of 10 cents per cubic yard. In them no allowance was made for right of way, for protection against erosion, or for contingencies, and they are based upon levees of admittedly inadequate heights. To determine the proper heights to which the levees should be built and their probable cost would require an accurate survey and considerable study. It is believed that the rough approximation made above is sufficient to show that the benefits to be derived from levees in such a narrow valley are not sufficient to justify their probable costs, even if their construction were accomplished by taking all of the material from the stream side and the improved channel condition taken into consideration.

61. The only other remedy to be considered for this section is that of reducing the flood flow by storage or detention reservoirs either to such a degree that no levees at all would be necessary, or to such a point that low levees which the farmers themselves could build would suffice. Reservoir sites exist on all the large tributaries above Chillicothe, and also on Paint and Salt Creeks below. (Pl. X.) Reservoirs on these two latter streams would serve to protect from inundation only a very short reach of river lands, as not far below these creeks backwater from the Ohio is felt. Alvord and Burdick have estimated that the cost of the reservoirs on the tributaries below Columbus and above Circleville would be about $6,000,000, with a consequent reduction at Circleville of 2.4 feet in gauge heights, and that with an additional reservoir on Deer Creek, which, in combination with those above, would reduce gauge heights at Chillicothe about 5 feet, the total cost would be about $7,000,000. If these were constructed in combination with those proposed for the protection of Columbus, the total cost would be about $15,000,000, of which amount $7,000,000 would have to be borne by the interests below Columbus. The resulting reduction of gauge heights would be 5 feet at Circleville and 12.5 feet at Chillicothe. It is evident that against a great flood similar in all respects to that of 1913, levees would still be required if total protection is to be secured. The expenditure of $7,000,000 for something considerably less than total protection to some 70,000 acres of land and the city of Chillicothe is not to be considered, from the standpoint of local benefit alone.

62. The works proposed for the protection of Columbus will give a considerable degree of relief to the section between Columbus and Chillicothe and to Chillicothe itself, and it would appear that, for the present at least, the lower valley will have to be satisfied with what benefit it can derive from such works as may be constructed primarily for the benefit of Columbus. These works alone, it is estimated, will reduce the gauge heights at Circleville 2.6 feet and at Chillicothe 7.5 feet, under conditions similar to those of 1913. Of course, in some other storm, the heaviest rainfall may fall on the lower part of the drainage area. In such a case the reservoirs above Columbus would be of less help.

63. *Local protection at Chillicothe.*—(Pl. VIII.)

Since the flood of 1913 some improvements have been made with the idea in view of preventing such a flood in Chillicothe in the future. The Norfolk & Western Railroad has rebuilt its bridge, making it 1,400 feet in place of 925 feet, as it was before the flood. The waterway opening has been increased from 20,500 square feet, as it was before the flood, to 37,300 square feet, an increase in area of about 82 per cent. With this improvement made, the people of Chillicothe feel that the whole flood situation has been remedied.

The Baltimore & Ohio Railroad has rebuilt its embankment along the City Park, strengthening it and raising its grade to a considerable extent. The city authorities have built a levee extending from the high bank east of the Norfolk & Western bridge for a distance of about 2,000 feet to the city limits. The county officials are expected to carry on the work along the river south past Chillicothe, but as yet nothing has been done toward this end. (Alvord and Burdick.)

64. The town could be protected by a complete levee system, as shown on Plate VIII.

COLUMBUS.

65. *Description.*—(Pl. II.) Columbus is located at the junction of the Olentangy and Scioto Rivers, about 100 miles above the mouth of the latter. At this point the Scioto and Olentangy Rivers debouche from their narrow gorges onto a broad flat flood plain about 2 miles wide, bounded by rising ground on the east and west. In this flood plain and built to the very banks of the two rivers, which unite in its midst, is the city.

66. The Scioto after leaving its gorge passes along the northern border of the flood plain to near its eastern edge, where the Olentangy joins it. It then makes a long curve to the southward, reaching in close to the bluffs on the east and then curving away from there to near the center of the flood plain, where it bends to the south again.

67. The principal business section of Columbus is spread along the eastern bank of the river and extends up the eastern bank of the Olentangy. The principal residence section is on the high ground to the east of the business section and beyond the business section on the Olentangy. Most of the city on the east bank, being on relatively high ground, was well out of the flooded area of the 1913 flood. The part of the city to the west of the large bend of the Scioto, known as the West Side, consists of the poorer residential section (about 25,000 people), factories, railroad yards, etc. This section, being on the low flood plain, was almost completely inundated in 1913, the flooded area being 2.5 square miles. This portion is traversed by five railroads on elevated embankments. The sector between the Olentangy

and Scioto Rivers was also inundated but is not very thickly populated. The city waterworks pumping station and purification plant are here.

68. *Levees.*—The low-water channel of the Scioto River through the city is about 300 feet wide, 15 feet deep, and has a slope of 3.6 feet per mile. This channel, even if entirely free and unobstructed, has insufficient capacity to carry the flood waters of the Scioto and Olentangy Rivers. With the growth of Columbus the channel has been considerably encroached upon, and the natural flood channel has been occupied and obstructed by numerous buildings and railroad embankments. In order to protect the city from these overflows and to confine the river within its banks, a levee system has been maintained, as shown on Plate XI.

69. These levees have been the result of a gradual growth and have been raised from time to time during the last 50 years as increasing flood heights, due partially to this work, seemed to demand. They have been built partly by private enterprise, partly by railroad, and partly by the city.

70. In the flood of 1898 the levees were overtopped and the West Side was badly flooded. As a result of this the levees were raised 6 feet above the flood stage of that year, which was supposed to provide for a flow of 25 per cent in excess of that of 1898. This was the last time that the levees were raised before the 1913 flood.

71. The following is a description of the levees now maintained:

First. The levee on the west bank of the Scioto. This levee is about 7 miles long and extends from a point about 2 miles west of the mouth of the Olentangy to a point about 5 miles below it. The height of the levee varies from 10 to 15 feet above the natural bank of the river.

Second. A levee on the east bank of the Olentangy River, extending from the Big Four Railroad bridge for about 0.56 miles nearly to the mouth of the Olentangy River.

Third. A levee along the east bank of the Scioto River from Mound Street to Humboldt Street, 1.25 miles long with average height of 10 feet above natural ground surface. This protects the low area occupied by the Hocking Valley Railroad yards and shops, the Franklin furnace, etc.

Fourth. A levee along the east bank of the Scioto River, extending south from Moler Street for a distance of 2.5 miles. This levee is from 6 to 8 feet high and protects truck garden and farm lands south of Columbus.

72. *Railway embankments.*—The numerous railway embankments on the West Side played an important part in the flood of 1913 and will therefore be described.

73. The embankment of the Big Four and the Toledo & Ohio Central Railroads comprise a part of the levee protecting the West Side on the north. These railroads follow this levee from their junction, about one-quarter of a mile west of Grandview Avenue, to the point where the Big Four turns to the northeast to cross the river. From this point the Toledo & Ohio Central continues on the levee to a point about 500 feet west of the north bridge of the Hocking Valley Railroad. This is the only portion of the levee used also as a railroad embankment and is about 1.9 miles long.

74. About a quarter of a mile to the south of this levee and parallel to it is the embankment of the Pennsylvania Railroad, which runs east and west through the West Side. This embankment is cut by five subways at Central, Lorain, and Rogers Avenues, and at Darby and Sandusky Streets.

75. The Baltimore & Ohio Railroad passes through the center of the West Side on an embankment running north and south. It is penetrated by four subways at Sullivant Avenue, Town, and Broad Streets, and at McKinley Avenue.

76. The Toledo & Ohio Central and the Hocking Valley Railroads, on closely adjoining embankments, cross the bend of the Scioto River from north to south between Lucas and Starling Streets. There are four subways at Rich, Town, State, and Broad Streets.

77. These railroad embankments are generally at the same elevation as the levee system, having been raised to that elevation shortly after the 1898 flood. They divide the West Side into five sectors, between which there is communication only through the subways.

78. *Bridges.*—The river is spanned at or near Columbus by 7 highway and 6 railroad bridges on the Olentangy and 10 highway and 6 railroad bridges on the Scioto. Three of the Scioto bridges are above the mouth of the Olentangy and 13 below. Nine bridges are within the first mile below the mouth of the Olentangy.

79. *Description of 1913 flood.*—The inundation of Columbus was caused by the overtopping of the levees when the flow had exceeded the channel capacity of the Scioto River with its levee system. The breaks and inundation occurred principally on the West Side where the total length of levee washouts was approximately 6,000 feet out of a total of about 23,000 feet of West Side levee within the city limits. There were 12 distinct breaks, ranging in length from 50 to 1,200 feet.

80. The first break occurred in the levee on the east bank, south of Mound Street. This was followed soon after by the overtopping and washing out of the Big Four levee north of the Pennsylvania embankment and west of the Baltimore & Ohio embankment. There were five distinct breaches which eventually widened to a total of about one-half mile in a length of 1 mile in this section of levee. The water rushing through these gaps soon filled the section inclosed by the Pennsylvania, Baltimore & Ohio, and Big Four embankments. This basin was filled to a depth of 15 feet, the water rushing from it through the subways and over a washout of the embankment at the junction of the Pennsylvania and Baltimore & Ohio tracks. The area bounded by the Pennsylvania embankment on the north and the Baltimore & Ohio embankment on the east was in turn filled to a depth of about 17 feet. This head caused the water to flow from this area into the district to the east of the Baltimore & Ohio embankment with great velocity. This area was also flooded by water which came from the north through breaches in the main levee east of the Baltimore & Ohio tracks and which in turn passed through the subways of the Pennsylvania, the Hocking Valley, and the Toledo & Ohio Central embankments. All of this water passed through the streets of the West Side with great rapidity, due to the slope of the ground toward the south, which was over 5 feet per mile.

81. The West Side was almost totally inundated by this flood, only four small areas remaining above water. The area submerged was about 2.5 square miles. The average depth of water was about 10 feet and over 1,200 acres were flooded to a depth between 10 feet and 17 feet. The maximum flood height was maintained for about seven and one-half hours.

82. A large area in the sector between the Scioto and Olentangy Rivers was inundated, but the damage was slight, due to the lack of development of this area.

83. The low area east of the Scioto occupied by the Hocking Valley Railway yards and the Franklin furnace was inundated when the levee below Mound Street was broken. There were five distinct breaks, totaling a length of 2,000 feet.

84. The district south of Greenlawn Avenue, on the East Side, was inundated. Here the levees were overtopped and a breach of several hundred feet was made just below the city railroad bridge.

85. *Damage.*—The principal damage occurred on the West Side, due to the velocity of water discharging from the subways under head and the current due to the rapid slope of the land, which washed away many buildings and damaged the streets by scour. In addition there was the usual damage resulting from inundation, the loss of 93 lives, four bridges over the Scioto, and the interruption of business, traffic, and the usual human suffering due to the loss of personal property and necessities of life.

86. None of the railroad bridges were washed out, though considerable damage was done to them. Four out of the six highway bridges between Broad and Mound Streets were wrecked, as follows:

Town Street Bridge, four 75-foot spans, three westerly spans out.
State Street Bridge, three 115-foot spans, entire bridge out.
Broad Street Bridge, two 160-foot spans, west span out.
Mound Street Bridge, one 291-foot span, entire bridge out.

87. The money value of the direct damage at Columbus is summarized from the report of Alvord and Burdick as follows:

	Value.	Damage.
Land and buildings in flood zone	$27,594,000	(1)
Municipal property	7,054,000	$496,000
State property	250,000	5,000
County property	567,000	84,000
Real estate	(1)	1,482,000
Furniture and household goods	2,510,000	1,705,000
Business houses and firms	3,600,000	1,008,000
Public service corporations	2,710,000	317,000
Red Cross and relief funds		200,000
	44,285,000	5,297,000

[1] Included in other items.

88. *Local protection.*—Shortly after this great flood and before the Ohio conservancy act had been passed, the city of Columbus employed Alvord and Burdick, consulting engineers, of Chicago, Ill., to prepare plans for the protection of the city of Columbus. These gentlemen submitted their report on September 15, 1913. In it they presented 13 alternative projects, varying in estimated cost

from about $10,000,000 to about $23,000,000. Some of the projects provided for channel improvements along the line of the existing stream, others provided a cut-off channel, and still others were combinations of either or both of these with detention basins. The recommendation was for project No. 7, which provided for a cut-off channel with levees above and below the city, at a total cost of $11,263,300 to be distributed as might later be determined among the various interests benefited. This recommendation was qualified as follows:

> Projects 9 and 10, combining reservoirs with channels, are not favored unless State aid and the cooperation of other municipalities benefitted be obtained. As between reservoir projects built by Columbus for its own protection and channel projects of equal cost we favor channel projects as being a more simple and reassuring method to the public directly concerned.

89. *Previous floods at Columbus.*—Before proceeding with a discussion of the more comprehensive plans which have been proposed for flood relief in the valley, the following data on previous floods, rainfall, run-off, etc., is presented. This collection of data is useful, principally, in aiding us to determine the "expectancy" for future floods, both as to their size and frequency of occurrence.

> As no continuous records of river stages on the Scioto appear to have been kept previous to 1896, the facts available about floods earlier than the flood of 1898 must be gathered from miscellaneous sources and are at best very meager.

90. Flood stage on the United States Weather Bureau gage at Columbus is 17 feet. This gage is located at Mound Street Bridge. Between this bridge and the junction of the Scioto and Olentangy Rivers were, before 1913, eight bridges. The narrowest of these had an opening only 290 feet wide at right angles to the thread of the current and the stream was lined with levees.

91. In their 1913 report Alvord and Burdick establish the fact, from the testimony of a reliable witness, that in the floods of 1865, 1870, and 1883 the water reached a height at a certain locality in the city which, if transferred by levels, would correspond to gauge heights of 17.3 in 1865, 18.88 in 1870, and 24.11 in 1883. Alvord and Burdick apparently and properly placed little reliance on the flood stages so determined. The elevation of flood waters in localities where local heads may be created is of little value, even for comparative purposes, unless all the conditions are thoroughly known. The following quotation from the United States Weather Bureau bulletin on 1913 floods, speaking of Columbus conditions, brings this out very clearly:

> These figures show that the water (of 1913) at the Weather Bureau gauge was only 1.6 feet higher than in 1898, although a 6-foot higher levee had been overtopped and washed out. The fact is that the water was held back by the bridges that cross it within the city limits, and the river was from 6 to 7 feet higher above the confluence of the two streams than in 1898.

92. Due to the fact, as indicated above, that conditions affecting gauge heights at Columbus have varied greatly in different floods, Alvord and Burdick decided to use Circleville gauge heights and a rating curve established there for the determination of flood flows previous to 1898. The result of their studies of previous floods is given in the following tables of "Maximum floods in 100 years at

Circleville and Columbus" and "Maximum floods in each year" (since 1898 at Columbus):

Greatest floods in 100 years at Circleville and Columbus, Scioto River.

Date.		Circleville, 3,214 square miles.		Columbus, 1,618 square miles.		Remarks.
Year.	Month.	Gage.	Flow.	Gage.	Flow.	
			Sec.-ft.		*Sec.-ft.*	
1913	Mar...	24.2	220,000	22.9	138,000	Levees overtopped at Columbus.
1898	Mar...	21.7	147,000	21.3	75,000	Columbus levees overtopped; levees lower than at present.
1904	Jan...	20.0	113,000	18.5	36,000	
1907	Mar...	19.3	100,000	18.9	37,200	
1884	....	19.3	100,000	....	....	West side said to have been flooded in Feb., 1883.[1]
1870	Jan...	18.8	88,000	....	....	Went over Columbus levee twice in January; levees higher than in 1865.[1]
1866	Sept..	18.7	87,000	....	....	Same at Schenck's, Sept. 14, 1865, that went all over west side; levees low.[1]
1833	....	18.7	87,000	....	....	Based on comparative heights at Shadeville as reported by Mr. Williams.
1868	....	18.1	78,000	....	....	
1860	....	18.1	78,000	....	....	

[1] Statement of John Schenck in Report on Columbus Flood Protection, 1913.

Maximum floods in each year—Scioto and Olentangy Rivers.

Date.	Mound Street, height at.	Flow in cubic feet per second.		
		Scioto.	Olentangy.	Lower Scioto.
1913, Mar. 25	22.9	*80,000	60,000	140,000
1912, Feb. 26	15.5	*18,100	7,400	25,500
1911, Jan. 30	12.0	8,500	8,000	16,500
1910, Mar. 1	19.5	*20,200	18,800	39,000
1909, Feb. 24	18.7	20,900	15,100	36,000
1908, Feb. 15	18.5	20,000	15,000	*35,000
1907, Mar. 14	19.0	21,200	15,800	*37,000
1906, Mar. 27	15.7	15,000	11,000	*26,000
1905, May 12	14.0	11,400	7,250	18,650
1904, Jan. 22	17.5	19,320	15,500	34,850
1903, Mar. 1	15.8	14,250	11,050	25,200
1902, Dec. 17	9.0	6,000	4,500	10,500
1901, July 5	8.5	5,640	6,900	12,540
1900, Mar. 7	10.0	9,000	7,470	16,470
1899, Jan. 14	13.2	13,480	10,500	23,980
1898, Mar. 23	21.3	43,000	32,000	*75,000

Note.—Rates are hourly maximum when marked thus: (*). 1909 to 1913 inclusive, floods on Scioto dam and total of two rivers by Mound Street gauge. 1899 to 1905, both rivers from United States Geological Survey gaugings. 1902, 1906, 1907, and 1908 totals from Mound Street gauge prorated to Scioto and Olentangy

From the above data and from the results of thorough inquiry, Alvord and Burdick draw the following conclusion:

There is good evidence upon the Scioto River that the flood of 1913, having an apex rate of 140,000 second-feet at Columbus, has not been exceeded in about 100 years. It may have been the greatest flood in a much longer period. Twice during this period a flood of 75,000 second-feet has been equaled or exceeded. The second flood came in 1898, and therefore this has happened twice within the past 18 years. The most conservative deduction that can be made from the record of the Scioto alone is that the 1913 flood may be expected once in 100 years upon the average, but as in all matters of chance it is always possible that the flood may be repeated or exceeded this year or any other year.

93. *Rainfall.*—The flood of March, 1913, was caused by a very severe rainstorm which extended over the entire drainage area of the Scioto River, beginning on March 23 and ending March 27. It was this storm which caused the excessive run-off from nearly all the northern tributaries of the Ohio, resulting in extensive flood disasters in Ohio, Indiana, and Illinois.

94. Before the storm the ground was unfrozen and saturated as a result of previous rains. At the beginning of the storm the river at Columbus was at about midstage, the gauge reading being 4.8. On March 24 the water had risen to 6.2; and the maximum stage of 22.9 was reached early in the afternoon of March 25, up to which time only about 7 inches of the total of nearly 10 inches of rain had fallen on the area above Columbus. (Pl. XII.)

95. The distribution of total rainfall over the Scioto watershed for March 23 to 27 may be seen on the rainfall contour map (Pl. XIII). It will be noticed that it was a maximum, 11 inches, near the source and diminished to 4 inches near the mouth of the river.

96. The daily amount of precipitation at United States Weather Bureau stations maintained in the watershed is given in the table below.

Daily amount of precipitation, in inches, at United States Weather Bureau stations in Scioto watershed, Mar. 23–27, 1913.

Station.	Mar. 23.	Mar. 24.	Mar. 25.	Mar. 26.	Mar. 27.	Total.
Cardington	1.02	2.55	3.00	1.40	0.00	7.97
Kenton	2.00	1.50	3.60	1.20	.35	8.65
Marion	1.38	1.97	4.39	1.87	1.00	10.61
Delaware	1.12	2.00	2.46	1.87	Trace.	7.45
Columbus	.53	2.14	2.89	1.40	.01	6.97
Ohio State University, Columbus	.60	1.89	2.42	2.54	.41	7.86
Circleville	.15	1.50	1.97	2.29	.37	6.28
Frankfort	Trace.	1.20	1.67	2.20	1.42	6.49
Chillicothe		.02	1.20	(1)	4.60	5.82
Waverly	.01	.26	1.29	2.57	.38	4.51
Portsmouth	.00	Trace.	.03	2.78	1.40	4.21

Both days included in Mar. 27.

97. The following table, showing the average rainfall in inches on the Scioto above Columbus, the Olentangy, the Scioto below Columbus, and the entire Scioto watershed, has been computed from rainfall records obtained by the United States Weather Bureau at various stations shown on the rainfall contour maps.

98. In obtaining these averages the areas between the contours were measured and the mean rainfall values for these areas were weighted in proportion to the size of the areas, thus eliminating the error arising from the stations being unequally grouped as to locality. These values compare very closely with values obtained by Alvord and Burdick.

Average rainfall, in inches, on the drainage area of the Scioto River and its tributaries, Mar. 23–27, 1913.

Date	Scioto alone above Columbus (drainage area=1,078 square miles).	Olentangy above Columbus (drainage area=536 square miles).	Total Scioto above Columbus (drainage area=1,614 square miles).	Scioto below Columbus (drainage area=4,867 square miles).	Total Scioto (drainage area=6,481 square miles)
Mar. 23	1.37	1.13	1.29	0.33	0.57
Mar. 24	1.80	2.00	1.87	1.08	1.28
Mar. 25	3.97	3.39	3.77	1.95	2.36
Mar. 26	1.66	1.62	1.65	2.06	1.95
Mar. 27	.59	.70	.63	.26	.33
Total	9.39	8.84	9.21	5.68	6.49

99. Rainfall records kept at the Ohio State University at Columbus for the 17 years preceding the year 1913 show that the rainfall of 7.86 inches recorded there during the five days, March 23, 24, 25, 26, and 27, has been exceeded but twice and equaled but once by the rainfall of an entire month during the 17-year period covered by these observations. Furthermore, in 2 consecutive days of 24 hours each more rain fell on each day—2.95 and 3.04 inches—than falls normally during an entire month for each of 8 months of the year.

100. *Run-off.*—According to discharge measurements made by Alvord and Burdick at the Columbus Storage Dam (corrected to Columbus) the total run-off (in the 1913 storm) of the Scioto River at Columbus between March 23, when the rain began, and April 3, when the river had returned to normal stage, was 500,000 acre-feet in round numbers. (Pl. XII.) The total rainfall on this area during the storm amounted to 540,000 acre-feet, in round numbers. All but 40,000 acre-feet, or 93 per cent, had therefore run off by April 3.

101. Reliable witnesses testify that—

> The water in the Great Scioto Swamp did not stop rising until three days after the crest had passed Columbus. (This would be on the 28th.) It then was from 3 to 5 feet deep over the entire swamp. It remained at that elevation for one week (which would bring us to Apr. 3), after which it fell slowly.

If this statement is to be credited at all, it would appear that either in the swamp itself (which contains some 18,000 acres) or in the stream between that point and the exit of the natural detention basin at Green Camp, the 40,000 acre-feet might well have been found. This would indicate that the run-off from the remaining part of the drainage area was probably close to 100 per cent; and, as there is no such natural storage in the upper Olentangy as on the Scioto, probably the 100 per cent run-off applies to all of the drainage area of that stream. The total run-off for the entire area above Columbus, therefore, may be closely estimated at the total rainfall less 40,000 acre-feet, or 752,800 acre-feet. (Pl. XII.)

102. The maximum channel through the city of Columbus is not now much over 50,000 cubic feet per second. This flow, maintained for 24 hours, however, would pass 100,000 acre-feet, or the entire run-off of the 1913 storm, in about 8 days.

103. Unfortunately for Columbus the water did not arrive at uniform rate. By 4 a. m. of March 25 the rate of flow, increasing

gradually, had reached 50,000 second-feet. By noon it had leaped to 140,000 second-feet. It remained at that rate for about 6 hours and then decreased to 50,000 second-feet again at 9 p. m. of March 27, returning to normal stage on April 3. (Pl. XII.) In the 65 hours from 4 a. m., March 25, to 9 p. m., March 27, nearly three-fifths of the entire run-off at Columbus occurred, and nearly half of this in the 24 hours from 4. a. m., March 25, to 4 a. m., March 26.

104. With this extremely rapid accumulation of run-off, the topography of the gorge section just above Columbus had much to do. (Pl. III.)

105. From Prospect to Columbus the upper Scioto Valley is a trough about 4 miles wide at the top, with side slopes of 1 on 40, rising 250 feet above the stream bed. The total fall of the stream from Prospect to Columbus is 160 feet, and about 110 feet of this occurs in the lower 15 miles. (Pl. XIV.) The Olentangy, which flows parallel to the Scioto and 4 miles from it, has the same characteristic valley for a somewhat greater distance.

106. It is evident that the water, falling upon these two troughs (the combined area of which is about 150,000 acres), will reach Columbus simultaneously and in a very short time.

107. Quoting from Alvord and Burdick—

> but the crest of the flood at Columbus was created by a rainfall on the watershed above of only about 6 inches in 2 days, of which one-half fell in the last 12 hours—

the center of this 6 inches of rainfall, however, was above this critical section, and much of the run-off was held back by natural detention basins on the summit section.

108. It is believed that a rainfall of 5 inches in two days centering on the critical section would produce as high, if not a higher, crest than that of 1913, and a rain of much shorter duration but approaching an intensity of 2.5 inches per day will overtax the present absurdly inadequate and restricted channel.

109. It is believed that an ideal protection for Columbus under such conditions would be dams, one at the mouth of each gorge, just above Columbus, with regulated discharge from the two reservoirs thus created, the construction of the dams being preceded by an immediate improvement of the Columbus channel to a safe capacity of at least 50,000 second-feet. There are difficulties in the way of securing this ideal solution. The Alvord and Burdick plans approach this idea closely.

PLANS OF FRANKLIN COUNTY CONSERVANCY DISTRICT.

110. In July, 1915, the Franklin County conservancy district was established and Alvord and Burdick appointed as chief engineers. This firm has continued and extended their studies which had been made as consulting engineers for the city of Columbus, and the period spent on the studies has now occupied nearly two years. The plan which is recommended in their report of March, 1916, may be summarized as follows:

111. Two detention basins are to be provided, one on the Scioto, the Dublin Dam (12 miles above Columbus), and one on the Olentangy, just above Delaware (25 miles above Columbus). Both dams

are to be of earth and both are to be carried approximately to the full height of the valleys.

112. The Dublin Dam is to be 143 feet high, 7,140 feet long, 980 feet wide at the base, and 25 feet wide at the top. The capacity, to within 10 feet of the top of the dam (left as freeboard), is to be 255,925 acre-feet. There are to be no openings of any sort through the dam itself. Three special tunnels through rock, one at elevation 840, and two at elevation 770, are to be provided, which will allow a flow when all are flowing together, of not over 30,000 cubic feet per second. These openings are to be uncontrolled.

113. The Delaware Dam is to be 82 feet high, 9,600 feet long, 550 feet wide at the base, and 25 feet wide at the top. Its capacity, with 10 feet freeboard, is to be 163,202 acre-feet. As with the Dublin Dam, no openings of any sort are to be provided in the dam, but two openings through the rock are to be provided at elevation 882 which, when flowing together, will discharge 12,000 cubic feet per second. The maximum discharge of the outlets from the two reservoirs will therefore be 42,000 cubic feet per second.

114. *Drainage area below dams.*—It will be noticed that there is still a drainage area below the Dublin Dam of 82 square miles on the Scioto, and below the Delaware Dam of 150 square miles on the Olentangy.

115. It is possible for this area alone to produce a run-off of approximately 27,000 second-feet, and should this be combined with the 42,000 second-feet of flow from the detention basins the safe channel capacity at Columbus would be dangerously exceeded. This safe capacity is about 35,000 second-feet.

116. *Flint Dam.*—To care for the excess above 35,000 second-feet Alvord and Burdick considered two methods: One, by building a dam at Flint 122 feet high, 3,930 feet long, 900 feet wide at bottom, and 25 feet wide at the top, provided with spillways and outlets as in the other two. The capacity of this reservoir would be 169,295 acre-feet, and the three would cut down the flow from the reservoirs to 37,000 second-feet. The maximum rate of flow past Columbus, therefore, if the three reservoirs are built, will be 37,000 second-feet, plus whatever flow would be added by the run-off from the 136 square miles of area below the Dublin and Flint Dams, or approximately 52,000 cubic feet per second. Evidently the levees at Columbus would need strengthening also.

117. *Channel improvement.*—As an alternative it was proposed (and this is a part of the final recommendation) that instead of the Flint Reservoir the conditions at Columbus be improved by widening and strengthening the levees and revetting them at bends so that, as improved, the channel will safely carry 50,000 second-feet with an ultimate capacity of 75,000 second-feet.

118. *Adequacy of the plans.*—The cost of the plan as recommended is estimated by Alvord and Burdick to be $10,250,000. If the Flint Dam were provided instead of the channel work at Columbus, the estimated cost of the work is about $12,000,000. As indicated above, even with the Flint Dam some improvement of the channel would be needed at Columbus.

119. Realizing that no such large expenditure would be justified unless the plans were ample to provide against all possible contingencies, Alvord and Burdick based their reservoir capacities and

the Columbus channel improvement upon a "standard storm" greater in intensity than that of 1913. This standard storm is assumed as of the same duration as that of 1913. The total run-off, however, amounts to approximately 1,085,000 acre-feet as against 752,800 for 1913, and the maximum rate of flow is 200,000 second-feet as compared with 140,000 second-feet in 1913, and at every hour the standard storm rate of flow exceeds that of the 1913 storm as 200 to 138. Plate XV gives the hydrographs of this standard storm with and without the detention basins. It will be noted that the maximum flow at Columbus for such a storm as regulated by the detention basins will be about 52,000 second-feet. This allows for 10,000 second-feet maximum rate of run-off from the 232 square miles of area below the dams at the critical time. It is possible that the maximum rate from this area would be greater than 10,000 second-feet from such a storm, but it is also probable that this subcrest would pass Columbus before the maximum discharge from the reservoirs reached Columbus. It is not believed, however, that the standard storm would test the Columbus channel beyond its proposed ultimate capacity of 75,000 second-feet and until this ultimate capacity is overtaxed no calamity should occur.

120. Plate XVI has been prepared for the purpose of graphically indicating reservoir capacities at different flow lines as determined from the best information available. In the case of Dublin, Delaware, and Flint reservoirs, this information consists of accurate surveys made by Alvord and Burdick and in the case of all others of Geological Survey maps—scale 1:62,500, contour intervals, 10 feet.

121. Plates XVII, XVIII, and XIX have been prepared for the purpose of testing graphically the Dublin, Delaware, and Flint reservoirs for the "standard storm."

122. From Plate XVII it will be evident that the water in the reservoir due to standard storm run-off will cease to rise when the total inflow has amounted to about 485,000 acre-feet. By this time the total outflow will have amounted to 221,000 acre-feet, leaving about 264,000 acre-feet as the maximum storage required.

123. From Plate XVI it will be seen that such a storage will be obtained when flow line is at elevation 901 if no spillways are provided. The elevation of top of dam as proposed is 910. A similar examination of Plates XVIII and XVI indicates that the flow line at time of maximum storage in the Delaware Reservoir would be at elevation 948.5. The top of the dam as proposed is 960.

124. Plates XIX and XVI indicate that at time of maximum storage in the Flint Reservoir the flow line will be at elevation 861.5. The top of the dam is 870.

125. *Spillways.*—Apparently without spillways the Delaware Reservoir is of ample capacity to care for the standard storm without encroaching upon the safe freeboard of the dam. The Dublin and Flint Dams as proposed have freeboards of 10 feet. The standard flood, if no spillway is provided, would reduce the freeboard to 9 feet at the Dublin Dam and to 8.5 feet at the Flint Dam. This would not be alarming. However, Alvord and Burdick have provided spillways for all the reservoirs for the reasons given in their report, as follows:

> It need hardly be said that the integrity of an earthen dam depends upon the adequacy of spillways, for unless the spillways are adequate the dam will be overtopped, and should the water pass over the top of the dam at sufficient

depth for a sufficient time the dam will be destroyed. In the case of the dam here considered, very adequate spillway capacity can be secured at little expense by allowing the water to flow over the side of the valley around the end of the dam into neighboring watercourses which exist at all three of the dam sites. In order to make a very adequate provision for spillway capacity a freeboard of 10 feet has been allowed between the crest of the spillway and the top of the earthen dam, and spillways of such width have been provided that a flood of 14 inches on the watershed in three days could pass the dam without overtopping the embankments. This requires a wide spillway at Dublin (1,600 feet) but practically no spillway at Flint and Delaware, the storage capacity being sufficient to absorb even the great flood above stated. However, spillways of liberal width can be secured by taking advantage of natural conditions, and even at Flint and Delaware spillways have been provided for.

* * * * * * *

Before the dams themselves could be overtopped a flood more than three times as great as that of 1913 would have to occur. Put it another way, such spillway outlets will alone pass two and three-quarters times as much water as the maximum flow delivered by the 1913 flood.

126. *Effect of Alvord and Burdick plans.*—The effect of the plans as described above according to Alvord and Burdick will be as follows:

The effect of the impounding dam above Delaware will be to completely protect that city from any damage from future floods. The gauge heights of the 1913 flood, for instance, would be reduced over 16 feet, and the amount of flow controlled to that which can be readily cared for within the present channel.

The effect at Columbus will be to reduce a future flood of 200,000 second-feet to not more than 50,000 cubic feet per second, which will be easily and safely carried by the improved channel before described. None of the railroads will be obliged to alter their bridges.

The effect at Chillicothe will be to prevent all danger of future floods inundating the city except on the low ground to the southeast. The height of a flood similar to that of 1913 would be reduced 7½ feet, and the east of the city would require a much less extensive levee protection than is now the case.

127. *The Sherman plan.*—In his paper entitled "The Ohio water problems," issued as No. 10 of Volume XX, Ohio State University Bulletins, Prof. C. E. Sherman, professor of civil engineering, presents a suggested plan for the complete treatment of "the entire Scioto and Sandusky Rivers for flood protection, for water power, for navigation, for ample water supply, and for other miscellaneous benefits" not incompatible with those listed.

128. The benefits to be secured from the plan as outlined are, as described by Prof. Sherman:

(1) A waterway costing one-third less per mile and having greater transporting capacity than the completed Erie Barge Canal; (2) lying directly on the route between the two greatest known ore and coal deposits in the world; (3) protecting from floods a far more valuable agricultural region than does the New York project (the Mohawk Valley is not secure from floods such as that of 1913 and does not compare in extent and richness of soil with the combined Scioto Valley and the flats west of Marion); (4) securing necessary flood protection to all cities throughout its 236 miles of length; (5) securing, for the future, water supplies for industrial and municipal purposes to all communities along the way which otherwise will be at much ultimate expense for such supply; (6) creating inland lakes which will greatly add to the pleasure and other miscellaneous uses which have already been listed—

and, as referred to elsewhere by Prof. Sherman, the development of valuable water power.

129. The works which are proposed to accomplish these purposes are:

(1) An impeding dam with detention basin above Delaware; (2) regulated storage reservoirs on the upper Scioto and Sandusky; (3) levees on the lower Scioto; (4) channel improvements at Columbus and Delaware; and (5) diversion of a portion of the Scioto drainage basin above Columbus into Lake Erie.

130. These five items taken together are called by Prof. Sherman the summit level project, and upon this portion of the final or more comprehensive project he has, because of the large amount of data available, been able to submit a more detailed study than upon the remaining items which contemplate—.

(6) Flood protection of the entire Sandusky Valley to Lake Erie by construction of Reservoir A; (7) flood protection for Scioto Valley to nearly Portsmouth (floods of the Ohio will extend some distance up the Scioto Valley, and, therefore, protection for the Scioto Valley complete can not be obtained by treatment of the latter stream alone) by construction of reservoirs on Deer, Paint, and Salt Creeks; (8) development of power on the streams treated both north and south of the divide; (9) construction of a 236-mile 10-foot waterway (9 feet on sills) across the center of the State; (10) combined rail and water terminals at all cities on the route from Portsmouth to Sandusky, including both of the latter.

131. It is evident that such a comprehensive project would cost a very large sum of money. Prof. Sherman believes that the benefits would be in proportion. He gives certain estimates of the ultimate worth of the benefits and these estimates seem to compare favorably with his estimated cost of the works. In conclusion he adds:

The foregoing estimate of the value of benefits from a comprehensive ultimate project is by no means accurate and complete, nor is it maintained that the ultimate project exactly as outlined in preceding pages is absolutely the best that can be devised. The example is given to emphasize the importance of treating streams for all benefits (rather than for just one) as contended for throughout this paper, and to show the necessity for an examination and survey on a comprehensive scale.

132. Prof. Sherman further contends that the entire project need not be undertaken at once, but that "portions of the ultimate project would be constructed as needed" and that the immediate need is for a proper solution of the portion immediately affecting Columbus of the summit level project. (Pl. XX.)

133. *Comparison of the two projects.*—Attention is here invited to the fact that Prof. Sherman's paper was largely prepared in 1913 and 1914 and was published in October, 1915, several months before the 1916 Alvord and Burdick report was submitted to the Franklin County conservancy district.

134. A comparison of the Sherman summit level project with the 1916 Alvord and Burdick project shows that the two differ largely in degree. Both plants provide for certain channel improvements at Columbus. Both provide for an impeding dam and detention basin above Delaware. Both provide for a high dam in the Scioto above Columbus. In the Sherman plan the location of the dam is at White Sulphur. In the Alvord and Burdick plan it is at Dublin. The latter is a higher dam and would cost more. However, it provides more reservoir capacity. Up to this point, therefore, the actual construction works needed and the cost of them appear about the same for the two plans. At this point the Alvord and Burdick project is complete at an estimated cost of about $10,000,000.

135. In addition to the works above described as being common to the two plans, Prof. Sherman's summit level project provides for a reservoir on the headwaters of the Sandusky River and a cut across the divide connecting this reservoir (shown as Reservoir "B" on Pl. XX) with the Dublin Reservoir. These additional works are estimated by him to cost about $10,000,000. The added benefits to be

secured by the larger project are given about as follows by Prof. Sherman:

> (1) Drainage of the large area flooded almost annually west of Marion (the Shield) (see Pl. II and XX); (2) storage of water available for power in future developments on both Sandusky and Scioto Rivers, but principally on the Sandusky; (3) an ample raw-water supply for Marion, Columbus, and all other cities in both valleys for 100 years in the future; (4) extension of flood-protection benefit to the Sandusky River Valley as far as the junction of Tymochtee Creek; (5) a 35-mile reach of navigable water available for barges of 9-foot draft if a waterway is eventually carried across the State; (6) lessening of flood discharge from Scioto into the navigable Ohio River.

136. It would indeed be unfortunate if these very important possibilities were overlooked by any flood-protection plan. They have not been overlooked by Alvord and Burdick. At the point where their project was said to be complete the estimated total cost amounted to about $10,000,000. The expenditure of this amount is expected to create certain assets for the conservancy district which will operate to reduce the "uncompensated cost of flood protection" to something like $6,000,000. These assets are described in the report as follows:

> *Land assets.*—Of this cost ($10,000,000) approximately $2,500,000 is allowed for about 21,000 acres of detaining basin land, herein estimated as purchased outright. Inasmuch as practically all of the land may be continuously cultivated it will retain its agricultural value. Flowage rights may be acquired only, or the land may be leased. If purchased outright, bonds may be issued to provide for payment, the interest of which will be offset by the cultivation or rental of the land, and a sinking fund may be established for the repayment of the principal. In this latter case the land is a valuable asset to the district, and its cost should not be treated as entirely a burden to the taxpayers.
>
> *Water-supply assets.*—It has been concluded that the city of Columbus is now short of storage for the water supply of the city, and that the present worth of future expenditures necessary for the purpose is at least $1,000,000. This cost would provide additional supply for the next 60 years. It is further found that by storing water in the lower part of the Dublin detaining basin after the flood season is past a supply for the dry period of late summer can be provided without serious danger to flood protection. The Dublin detaining basin therefore would be worth not less than $1,000,000 to the Columbus water supply.
>
> *Other assets.*—There is included in the estimated cost of this plan the rebuilding of city and county bridges destroyed in the 1913 flood. This amounts to $620,000, and is not really a part of the conservancy district's work, but should be financed by the city and county.
>
> There are also minor assets in increased flow in the river in dry summers, more diluting water for sewage purification, and in water for steam production, condensation, and other purposes.

137. In addition, Alvord and Burdick entered into the study of a possible water-power development in connection with their plans, and also the adaptability of this plan to suit a future, more comprehensive plan. The following is quoted from their conclusions:

> *Water power.*—An investigation has been made to determine if water power can be profitably developed as an asset to the project, and it was concluded, from a study of past records, that storage for water power would have to be made at times when flood protection was most needed. With charges for reservoir capacity thus necessarily obligated, power delivered in Columbus would not be as low in cost as that now developed in the municipal light plant. It is concluded, therefore, that water power is not a valuable asset at present.
>
> *Navigation.*—Should the United States Government conclude to build a navigable waterway connecting the Ohio River with Lake Erie, the project herein outlined can be readily adapted, both to that purpose and to the summit level diversion into the upper Sandusky River, suggested by Prof. Sherman.

Low flood protection.—It is practicable to provide for the control of low floods in this project, as in the Greater Scioto project, and by this means prevent a great deal of the crop damage likely to occur from summer floods. The function necessarily assigns a certain amount of the lowest basin capacity (about one-tenth) for that purpose.

* * * * * * *

Effect of drainage in upper watershed.—A study of the shallow natural detaining basins above Prospect and Kenton would seem to show that very long and exceedingly costly channel improvements will be necessary to completely eliminate their effect in restraining floods below them. However desirable this improvement might be from the standpoint of the valuable lands within these basins, it is believed to be virtually prohibitory in cost when limited to benefits on agricultural values alone. Some form of modified drainage preventing damage from lighter, summer crop destroying floods is probably all that is practicable now, and drainage on this scale will not radically affect or destroy the value of the basin at Dublin suggested in this report.

138. *Interest of the United States.*—The instructions under which Alvord and Burdick have studied this subject were—

> To investigate and report on the scope, character, and cost of the works necessary to protect either the entire Scioto Valley, or such portion of the same as would seem desirable and economical to protect at this time, the boundaries of the Franklin County conservancy district being, under the act, capable of enlargement to meet the best interests of those concerned.

139. In considering the scope of their project it must be remembered that the engineers were limited by the requirement that local benefits must exceed local assessment. In other words, it was not "sufficient to show that the aggregate of benefits exceeds the total assessment. It must further be shown that the benefits are such that reasonable assessments in each part of the district do not exceed the local benefits and are properly commensurate with equity."

140. It is apparent, therefore, that if a more comprehensive plan is to be undertaken the additional cost must be considered from the point of view of benefits of a general character, which can not be accurately assessed against any particular property, but which may be returned, in part at least, to the State or Nation in increased taxable values. It is understood, of course, that the damage done in this valley was by no means confined to property lying in the valley. There were indirect losses to business, etc., difficult to compute, but which, on the whole, were enormous.

141. The total estimated losses according to Alvord and Burdick, both direct and indirect, in the valley are as follows:

Summary of 1913 flood damage below proposed detaining basins.

	Direct.	Indirect.	Total.
Chillicothe City	$855,000	[1]$1,851,000	$2,706,000
Rural	1,114,500	[2]1,423,340	2,537,840
Columbus	5,291,000	9,070,000	14,361,000
Delaware	351,000	444,000	795,000
County roads and bridges	1,289,700	....	1,289,700
Railways	1,613,900	2,494,500	4,108,400
Villages	57,000	....	57,000
Total	10,572,100	15,282,840	25,854,940

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[1] Business loss based on ratio between direct and indirect damage (exclusive of real estate depreciation) at Columbus.

[2] Depreciated value of farm lands.

142. In this table it will be noted that the loss in the summit section is not included, nor that below Lucasville on the lower Scioto. Those in the summit section were not very great in 1913. They are greater in summer storms. The loss below Lucasville was due to backwater from the Ohio. These other losses are not needed to make the figures impressive. It is not known whether the project recommended by Alvord and Burdick will be carried out by the conservancy district. Many difficulties are yet to be solved. It is not known what part the State of Ohio will take in the matter. In accordance with the law directing this report the interest of the United States must be based upon protection to navigation. It is believed that this has reference not only to present existing navigation but also to reasonable future navigation possibilities. It is assumed therefore that it will not be improper to consider the possibilities of a future improvement on the Scioto.

143. In accordance with this belief an effort has been made to determine the value to the United States of an Ohio River-Lake Erie canal along the lines suggested by Prof. Sherman.

144. *Value of an Ohio River-Lake Erie canal.*—In order to determine the traffic possibilities of an adequate canal connecting the Ohio River with Lake Erie, Prof. Sherman was asked to present a further and more detailed study of this phase of his "Ohio Water Problem." This he did in cooperation with Mr. J. G. Young, traffic manager of the Columbus Chamber of Commerce. The results of their studies were given in the form of letter to the district engineer office, which, with published reports upon this subject, was given consideration.

EFFECT OF SCIOTO FLOODS ON THE OHIO.

145. A mass curve showing accumulated discharge of the Scioto River at its mouth is shown on Plate XXII. The curve was constructed as follows:

146. A mass curve for the river at Mound Street gauge, Columbus, had previously been constructed from a rating curve prepared by Alvord and Burdick and United States Weather Bureau gauge readings. This curve covers the period from 1898 to 1915. From the monthly mean rainfall at various stations in the drainage area above Mound Street, Columbus, the properly weighted mean for the area was determined. From these and the mean monthly discharge values used in constructing the mass curve for Mound Street, the per cent run-off was determined for each month. By the same method as before, properly weighted values of the mean monthly rainfall for the entire drainage area of the Scioto were determined. The per cent run-off values, as determined for the area above the Mound Street gauge, were then applied to the corresponding rainfall means for the entire drainage area and the discharge values thus secured properly plotted.

147. It is believed that the result is fairly correct, in so far as total accumulations are concerned. It can not be expected, however, from such a method that the rates of accumulation are accurate.

148. A mass curve for the Ohio River at Louisville covering the same 17-year period has been constructed from a rating curve and daily gauge readings furnished by the district engineer, Louisville, Ky.

(Pl. XXIII.) The results of a comparison of the Ohio (at Louisville) curve and the Scioto curve appears in the table below:

	Scioto.	Ohio at Louisville.
Drainage area	6,481 square miles; 4,147,840 acres.	91,190 square miles: 58,361,600 acres.
Total flow, 17 years	66,820,869 acre-feet	1,450,064,900 acre-feet.
Average yearly flow	3,930,639 acre-feet	85,297,935 acre-feet.
Maximum yearly flow	6,400,000 acre-feet	115,000,000 acre-feet.
Minimum yearly flow (1913)	1,650,000 acre-feet	63,000,000 acre-feet (1907).
Average rate of flow (1900)	5,385 second-feet	116,846 second-feet (1900).
Maximum recorded rate of flow (1913)	320,000 second-feet (estimated)	760,000 second-feet (from rating curve).

149. From the table it will be seen that the drainage area of the Scioto, at mouth, is about 1/14th of that of the Ohio at Louisville, while the ratio of the total run-off from the two areas is 1/21.7. During dry years the Scioto drainage supplies much less water than its proportion. In 1900 the ratio was as 1/38. In wet years, however, it supplies as much or more than its size would indicate. For example, in 1913 (a wet year) it supplied 1/16th of that at Louisville. In 1904 it supplied 1/11th of that of Louisville.

150. *Flood of March-April, 1916.*—From March 17 to April 2, 1916, there occurred in the Ohio Basin a rainstorm covering almost exactly the same period of time as did the 1913 storm. Conditions of ground, temperature, location of storm center, etc., were practically the same in both cases. The storm being smaller, however, the storm center did not cover as much area as in 1913. A careful study of the data secured for the 1916 storm has been made and a comparison of this storm and that of 1913 has led to certain conclusions which it is believed may be of value in determining the effect of tributaries and regulation works on tributaries upon floods in the main stream. In this study the stretch of the Ohio from Dam No. 31 (3 miles below the entrance of the Scioto) to Dam No. 41 at Louisville was considered as a natural reservoir.

151. For the 1916 storm the following table gives the reservoir conditions at the epoch of crest at Louisville (Pl. XXIV):

DEMAND.

	Acre-feet.
Accumulated discharge from reservoir from Mar. 21 to Apr. 2 (beginning of rise to time of crest)	6,840,000
Remaining in main river on Apr. 2 (stage varying from 53 feet at Louisville to 48 feet at Dam 31)	3,025,000
Remaining in mouths of main tributaries (Kentucky, Miami, Licking, Little Miami) on Apr. 2	150,000
Total	10,015,000

SUPPLY.

Amount in reservoir at beginning of storm (Mar. 31), stage varying from 22.5 at Dam 31 to 27.2 at Dam 41	1,500,000
Supply from upper Ohio (measured)	6,302,375
Supply from Scioto (at Waverly, 900,000—5,700 square miles; below, 97,625—781 square miles)	997,625
Supply from Great Miami at Venice (4,965 square miles)	450,000
Supply from Little Miami at Perintown (1,659 square miles)	165,000
Supply from Licking at Falmouth (3,200 square miles)	300,000

	Acre-feet.
Supply from Kentucky River (drainage area, 6,912) estimates same run-off per square miles as from Licking (74)	511, 488
Supply from drainage area immediately tributary to Ohio (5,664 square miles) estimated at average of Little Miami, Big Miami, and Licking as 85 acre-feet per square mile	481, 440
Total supply	10, 247, 928

152. The difference between the total supply, 10,247,928 acre-feet and total demand, 10,015,000 acre-feet as given, is 232,928 acre-feet. This error, which amounts to about 2½ per cent, is believed to be almost entirely in stream storage computations which were based upon but few sections. A study of the rainfall producing the run-off of March-April, 1916, has been made and measurements from a rainfall contour map check very well with the results given above.

153. For the 1913 flood no discharge measurements are available for "supply to the reservoir" except at Waverly on the Scioto. The "Demand" is known closely, however, from the Louisville rating curve and hourly gauge readings. (Pl. XXV.) The "Supply" portion of the table, therefore, has been made up by comparisons between the rainfall of the 1913 and the 1916 storms and the measured supply of the 1916 storm. It is believed that the results indicate with a fair degree of accuracy the reservoir conditions for 1913.

Portsmouth-Louisville Reservoir.

1913 storm.

DEMAND.

	Acre-feet.
Accumulated discharge at Louisville from Mar. 24 to Apr. 8–9 (beginning of rise to time when stage returned to 53 feet)	20, 600, 000
Remaining in main river at epoch	3, 025, 000
Remaining in mouths of large tributaries at epoch	150, 000
Total	23, 775, 000

SUPPLY.

Amount in reservoir at beginning of storm	1, 250, 000
Supply from Scioto (at Waverly, 2,275,620; below, 292,875)	2, 568, 495
Supply from Great Miami at Venice	1, 800, 895
Supply from Little Miami	495, 000
Supply from Licking	720, 000
Supply from Kentucky	1, 534, 464
Supply from 5,664 square miles drainage area immediately tributary to the Ohio between Portsmouth and Louisville	1, 444, 320
Balance to be supplied from Ohio above Portsmouth	13, 952, 236
Total supply=total demand	23, 775, 000

154. In the 1916 storm (which just reached flood stage) there was supplied from the beginning of the storm to the time of crest at Louisville about 10,000,000 acre-feet. The period during which this amount was supplied was 13 days. From time of crest the river fell quite rapidly. It might, of course, have held to stage 53 feet for an indefinite time without causing flood conditions at Louisville. Had it held to this stage for three days, a further flow of 3,000,000 acre-feet would have occurred, making a total flow of 13,000,000 acre-feet in 16 days. It is believed that the 1916 storm discharge curve as thus altered is a fair measure of the amount and rate of supply which

the river reservoir between Louisville and Portsmouth can care for without causing floods. It is therefore the "Capacity-supply curve—53-foot stage." This curve is shown on Plate XXV.

155. From the table of "Supply" for the 1913 flood it will be noticed that in the 16 days from the beginning of the rise to the time when the river had returned to stage 53 feet at Louisville, there had been supplied to the Portsmouth-Louisville river reservoir about 22,500,000 acre-feet of water, and of this amount the drainage area between Portsmouth and Louisville supplied the following:

Scioto	2,568,495
Great Miami	1,800,895
Licking	720,000
Kentucky	1,534,464
Little Miami	495,000
5,664 square miles of area immediately tributary to the Ohio	1,444,320
Total	8,563,174

This is eight-thirteenths of the total capacity of reservoir in 16 days. The water from this section reached the reservoir so quickly that it alone caused the flood stage from Portsmouth to Louisville to be overtopped. This is seen very clearly on Plate XXVI. Could it have been held back to the capacity-supply curve and could the water from the upper Ohio similarly have been held back, there would have been no flood. Can this be done?

156. The supply from the Little Miami and from the 5,664 square miles of drainage area immediately tributary to the Ohio amounted to nearly 2,000,000 acre-feet. This amount can not be controlled economically, if at all. It is believed that the Scioto can be regulated by reservoirs to about its 1916 storm discharge. This would reduce the amount which it would supply in 16 days to 1,575,000, which is about 60 per cent of that supplied in 1913 in 16 days. If the Great Miami, Licking, and Kentucky could be similarly regulated, the supply from these sources would amount to about 2,500,000 acre-feet. The total supply would then be:

In 16 days.
2,000,000
1,575,000
2,500,000
6,075,000

This is about 70 per cent of that which was supplied in 1913. If the Ohio above Portsmouth could be cut down similarly, the regulated supply from it in 16 days would amount to about 10,000,000 acre-feet. Adding this to the 6,000,000 regulated supply from the Portsmouth-Louisville section, makes the total supply 16,000,000 in the 16 days. This is 3,000,000 acre-feet in excess of the capacity-supply curve. It is evident that still closer regulation would be needed to avoid exceeding flood heights in the Ohio.

157. To get an idea, if practicable, of how the flood waters regulated to this degree, however, would arrive, an accumulation curve was drawn from the 16,000,000 acre-feet 16-day point (Pl. XXV) to the origin by proportioning between the accumulations of the capacity-supply curve and the 1913 flood curve and from the resulting accumulation curve the flow curve was plotted directly.

158. This curve and its method of derivation are shown on Plate XXV as "Rate of flow (70 per cent of total 1913 flood wave supplied in 16 days)." From this it will be seen that at the time of crest at Louisville for such regulation the flow will be at the rate of 625,000 second-feet, which corresponds to a stage of about 60 feet at Louisville. This is 10.5 feet below the crest of 1913 storm.

159. In the above it will be noted that but 70 per cent of the total storm supply of 1913 has been taken care of. The remaining 30 per cent (or 6,500,000 acre-feet) must not, of course, be allowed to accumulate in the river reservoir faster than at the rate of 1,250,000 acre-feet per day. Under such regulation, if it were possible, a flood wave like that of 1913 would last for about 21 days, and of this period the stage would be above 53 feet for about 17½ days, but not above 60 feet; while in the 1913 storm it was about 53 feet for 14 days and above 60 feet for 11 days. The fact is emphasized that it may well be impossible to attain the above results. The study is based upon conditions on the Scioto drainage area, which is but one-fourteenth of the entire drainage area above Louisville. In the 1913 storm this stream supplied one-ninth of the total amount of water which entered into the flood at Louisville. By a very radical use of practically all of the reservoir possibilities in the Scioto Valley, it is believed that this stream can be regulated to the degree required in the above study. The cost of such radical regulation would be great. It would amount to a larger sum than that estimated for the Alvord and Burdick great Scioto project.

160. It is known from studies of the Miami drainage area that regulation to the same degree is impracticable there, because of the lack of available reservoir capacity at suitable localities. Perhaps a greater degree of regulation is possible on other tributaries, and the lack of regulation of the Miami might thus be compensated for. To determine this would require surveys and more extended studies.

161. The benefit to navigation of such a reduction of flood heights would not be great. To benefit open river navigation materially, it would be necessary to utilize a large portion of the available reservoir capacity for the purpose of holding back water for discharge during the dry months. There is little enough reservoir capacity in this valley available for flood protection alone.

162. The board finds that the benefit to navigation of flood protection is a difficult matter to determine from data at hand, upon the tributaries of the Ohio River, which stream is now being provided with a continuous system of locks and movable dams. While the United States may not be justified in the interests of navigation on the Scioto alone in cooperating with the State of Ohio and other communities and interests in devising or carrying out plans for flood protection on this river, the effect of each important tributary of the Ohio River upon the operation of the Ohio River dams and the resulting navigation of that important water highway is such that more complete data concerning the flood problem of this stream should be obtained. On these grounds the board believes that the question of preparation of plans and the extent of cooperation should be fully investigated.

163. The Federal Government, through the Weather Bureau and other agencies, is already engaged in the collection and publication of information and data which will not only be of great value in

the final solution of the flood problem, but which now contribute materially in reducing the losses from floods by giving warnings of coming high waters, thus enabling property owners to undertake such rescue or preventive measures as time and circumstances permit. A further reduction in flood damage can, in the opinion of the board, be secured through the agency of the United States by the extension of the authority of the Federal Government so as to give it control over streams in the interest of flood protection similar to that provided in the interest of navigation by the act approved March 3, 1899. Control over waterways in the interest of navigation has been limited to those channels susceptible of actual navigation, and to a certain extent to an indeterminate area beyond, within which area control over the tributaries is necessary to the proper protection of navigation in the main channels. Control over waterways in the interest of flood protection must of necessity include practically the whole stream and its tributaries without any limitations imposed by any relationship to the interest of navigation.

164. The board in prior reports, printed in House Documents No. 246, Sixty-third Congress, first session, and No. 914, Sixty-third Congress, second session, endeavored to point out the practical impossibility of a proper control of streams for the purpose of flood protection, when the dividing line between control by the United States by reason of relationship to the interest of navigation, and control by the several States by reason of their sovereignty is incapable of exact or even approximate determination. It there stated (par. 16, Doc. 246):

> The board has been much impressed in its examination by the evils of divided control of the watercourses. The obstructions which have been placed along the various streams ought never to have been put there, and their construction should have been prevented, but since the control of rivers is in the twilight zone between the spheres of Federal and State authority, it developed that what was anybody's business was nobody's business, and no effective authority has been exercised by anybody. These rivers are feeders of a navigable stream and have an important effect upon the regimen of the Ohio River, and it is the opinion of the board that the authority of the United States should be exercised to prevent encroachments upon them exactly as in the case of navigable streams. It is believed that this is the only method of control which promises good results in practice. The board further urges that immediate steps be taken to exercise such authority, since bridges and other structures are to be rebuilt at once and there is evident danger in several places that they may be rebuilt in an obstructive manner.

165. Control over our waterways for the purposes of flood prevention and protection must, in the opinion of the board, be delegated to one central authority before any rational plan for flood control can be devised, and compliance with such plan, or other measures for the amelioration of flood conditions properly enforced. This central authority is logically and necessarily the Federal Government.

166. The board wishes to emphasize its opinion, however, that such control should preferably not be based on the uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that will accrue in the protection of life and property from loss and the interruption by floods of general interstate commerce and the interference with the mails.

167. No method of flood protection, even for a limited locality, should ever be adopted without a study of the effect of the proposed

plan upon flood conditions in the stream both above and below the point where the contemplated changes are to be made. For it is evident that a plan considering only the local effect may have the result of increasing flood heights at other points. If the plan contemplates holding back the water at a certain point, the result can be secured only by damming it back at that point with consequent increase of height at localities immediately above. If it provides for an improved channel, or otherwise for increasing the rate of flow past the point, the result will be the pouring of more water in a given time upon the stream immediately below than it would otherwise have received, and a possible flooding of localities which might have escaped. No method changing the conditions at one point can be adopted without changing the conditions at other points, and care must be taken that while the beneficial effect is secured at one locality the results at the other localities affected are not unreasonably detrimental.

168. No method should be adopted without careful consideration and an accurate comparison between the value of the protection afforded on the one hand and the cost of the changes themselves combined with the damages to other localities on the other. A reservoir might be used to protect a community and the cost of the creating dam be reasonable, but the value of the land taken for the reservoir might make the cost of the remedy out of proportion to the trouble which it is intended to relieve. The building of levees may secure a community from high waters, but the increased flood heights at other points will involve the building of new levees or the giving of additional height and strength to old levees at other places, unless the trouble is to be merely transferred. The cost of these new levees and of the additions to the old ones thus becomes an item of the cost of protection which should receive consideration. Too often the plan of flood protection adopted by one community is that selected solely for its relatively small cost and without the cooperation of or consideration for other parts of the river.

169. A dam either for impounding the water or restraining the flow can not be utilized without flooding a tract above it depending in area upon the height of the dam and the steepness of the ground. In very hilly or mountainous districts, as upon the tributaries of the Monongahela, the valleys will be deep and the reservoirs narrow and long, while the value of the land for agricultural purposes will probably be small per acre, although where there are coal mines or coal deposits the mineral value of the land may be large. Where the land is only moderately hilly or rolling the dam will be less in height but the reservoirs will be much larger in area and shallower for a given capacity than in a mountainous region; the land will also probably be of higher value per acre, so that its cost will be high, if not excessive. It must also be remembered that the damage from floods is only occasional, in some instances even rare, but that the withdrawal of land for an impounding reservoir is immediate, continuous, and perpetual, while for a restraining reservoir its use is so modified and uncertain that its present and future value will be greatly impaired. Thus a reservoir cost, which is in itself smaller than the money value of the protection it affords, may by its interest charges amount to much the larger sum in the course of a few years.

199. Most streams have low-lying lands along their course which are overflowed by the stream as soon as it rises beyond its banks. These lands, technically termed the flood plain, form a natural reservoir of greater or less capacity, depending upon their extent and the depth to which submerged.

200. Levees diminish the natural reservoir capacity of the stream. Where a flood overspreads the natural low lands along a river the current across these overflowed lands is usually gentle compared with that in the stream channel unless some artificial obstruction, such as road embankments or fills for other purposes so contract the waterway at some point as to cause a backing up of the water there. An overflow without strong current is seldom harmful to the land, and is not ordinarily objectionable unless it enters buildings or occurs when crops are in the ground. On the Ohio and its tributaries floods have usually occurred too early in the season to interfere materially with crops, while along the lower Mississippi, owing to the earlier season in the more southern latitude and to the later arrival of the flood waters at this part of their course, the overflows are apt to damage or destroy the season's crops. Levees, by diminishing the natural reservoir capacity of the stream, throw the waters into the lower river more quickly and to a greater height than would otherwise occur. Levees of insufficient height or without proper channel capacity between them are liable to fail or be overtopped in excessive floods, with the resulting damage to large areas of the land which they are intended to protect, for the suddenly loosed waters either wash away the top soil or cover it with a layer of sand and gravel. A levee built by a community for the protection of one side of a river only is rarely placed with any regard to the width of the waterway requisite to carry the flood flow or to the interests of the property owners on the opposite bank, unless the location is supervised by some competent authority. The board knows of one case where a drainage district recently built a levee along the banks of a river and so close to the stream that had the people on the opposite side built one similarly situated the area of the channel left between the two levees would have had a capacity sufficient for only one-fifth of the water carried in freshets occurring every few years. There is no method of flood protection requiring more intelligent supervision than the proper establishment of levees, and there is none for which one authority having jurisdiction throughout the length of the stream is so greatly needed to secure safe results, not only to protect one community against another but at times to keep a community from damaging itself, for an improperly placed or poorly built levee is certain to do one or both.

201. In those States which have a regularly organized commission or other body legally empowered to supervise plans for flood protection and to veto improper projects or hastily considered plans, something can be done to prevent one community from injuring another, but in many States the people on one portion of a river have but little or no redress against the work detrimental to them which may be undertaken by the people upon another portion. Even where such a commission exists it is in many respects powerless to prevent constructions which are recognized as inadvisable and known to be dangerous. An instance which was recently brought to the atten-

tion of this board was that of the commissioners of a county building a bridge across a stream within the limits of a certain city. For economical reasons the bridge was made as short as possible and did not provide sufficient space underneath for the heavier floods to which the stream was liable. The city endeavored to prevent the building of the bridge and attempted to secure the adoption of some other plan which would not interfere with the high-water flow, but was unsuccessful. The stream was not one regarded as ordinarily navigable, and appeal was not made to the War Department. It is doubtful if any State authority exists in most States to prescribe the amount of opening which must be left for the passage of flood waters at any bridge or in a railroad or highway embankment across the bottom lands adjacent to a river, or to prescribe the height of such embankment provided the proper openings are not made. Only Congress can exercise controlling authority where the questions arise between parts of a stream in different States.

202. It is probable that the Federal Government has control over conditions affecting floods in streams upon other grounds than the resulting influence upon navigation, although Congress has as yet not seen fit to exercise such control of nonnavigable rivers upon these other grounds. The flood of 1913 throughout the States of Ohio, Indiana, and Illinois interfered with mail communication and obstructed commerce between the States. The damage which this flood caused would have been lessened, and the interruption of commerce and of the transmission of the mails would have been less serious and of shorter duration had there been some supervision and control of the embankments and fills which had been made upon the stream channels. The same results occur in other floods and upon other rivers throughout the country, and as long as there is no authority to supervise the constructions along the stream and none to enforce a reasonable regulation, the interruptions of commerce and mail carriage will continue. That an excessive erosion upon a tributary which is not navigable will eventually produce conditions in the main stream which is navigable is probable, but the result is remote and depends upon so many contingencies of irregular occurrence that the connection between any particular encroachment or inadequate construction and a shoaling in the main stream is too remote to permit an enforcement of proper conditions upon the theory of effect upon navigation.

203. The board has already expressed its opinion that the devising of plans for flood protection on the Miami River can not be undertaken without the accumulation of further data than is now in its possession, and that this data should be secured, but it regards it as of prime importance as a first step in proper flood protection that the War Department, which has in recent years endeavored to do all it could in the general interest of flood protection under existing laws, should have its hands further strengthened and supported by additional legislation. Congress has recently recognized the importance of this subject by creating a new committee upon flood protection and this board recommends that the authority of the War Department, which now exists upon navigable waters, be extended so as to give it supervision over all structures and constructions hereafter placed upon nonnavigable streams which may un-

duly interfere with stream flow and increase flood heights and flood damages and interfere with interstate commerce.

204. To secure the data necessary for the preparation of flood protection plans called for under the act and for the exercise of proper supervision the board recommends a survey as indicated in paragraph 191.

Lansing H. Beach,
Colonel, Corps of Engineers, United States Army.
Edgar Jadwin,
Lieutenant Colonel, Corps of Engineers, United States Army.
T. H. Jackson,
Major, Corps of Engineers, United States Army.
P. S. Bond,
Major, Corps of Engineers, United States Army.
Geo. R. Spalding,
Major, Corps of Engineers, United States Army.
W. P. Stokey,
Major, Corps of Engineers, United States Army.
Robert R. Ralston,
Major, Corps of Engineers, United States Army.

[For report of the Board of Engineers for Rivers and Harbors see p. 6.]

PRELIMINARY EXAMINATION OF MAUMEE RIVER AND ITS TRIBUTARIES, OHIO AND INDIANA.

War Department,
Office of the Division Engineer,
Central Division,
Cincinnati, Ohio, June 3, 1916.

From: Senior Member Board of Officers on River Floods.
To: Chief of Engineers, United States Army.
Subject: Preliminary examination of Maumee River and its tributaries, Ohio and Indiana.

1. Pursuant to instructions contained in E. D. letter of December 14, 1915, the board of officers on river floods (constituted by S. O., No. 3, O. C. of E., 1913, as amended by subsequent orders) submits the following report on the preliminary examination of Maumee River and its tributaries, Ohio and Indiana.

2. This report is based on information furnished to the board by district engineer officer at Cleveland, Ohio, to whom the duty of making the preliminary examination was assigned by E. D. letter of April 16, 1915.

3. The examination was authorized by the following item of the river and harbor act approved March 4, 1915:

> The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities:
>
> * * * * * * *
>
> Maumee River and its tributaries, Ohio and Indiana, * * * with a view to devising plans for flood protection and determining the extent to which the United States should cooperate with the States and other communities and interests in carrying out such plans, its share being based upon the value of protection to navigation.

The Maumee River is formed by the junction of the St. Marys and the St. Joseph Rivers at Fort Wayne, Ind. Its general course is east-northeasterly to Maumee Bay, a portion of Lake Erie, the mouth being about 4½ miles below the business center of the city of Toledo, Ohio. From Fort Wayne to the mouth is 95 miles in a direct line and about 125 miles by river, of which 25 miles are in Indiana and 100 miles in Ohio. The St. Joseph River rises in Michigan and flows southwesterly through the northwestern corner of Ohio to the junction with the St. Marys. The latter rises in Ohio and flows northwesterly. From the junction the Maumee flows back between the basins of these two rivers.

5. The Tiffin River, from the northeast, and the Auglaize River, from the southwest, are tributary to the Maumee at Defiance, about half way from Fort Wayne to Toledo. The Blanchard and Ottawa Rivers are tributary to the Auglaize.

6. Drainage areas are approximately as follows:

	Square miles.
St. Joseph River	1,169
St. Marys River	934
Tiffin River	665
Auglaize River	2,461
Maumee River	1,495
Total, Maumee system	6,724

7. Drainage areas of the entire system above various points are approximately:

	Square miles.
Mouth of Maumee River	6,724
Napoleon, Ohio	5,835
Defiance, Ohio	5,677
Defiance, above the Auglaize and Tiffin	2,551
Ohio-Indiana State line	2,468
Fort Wayne, Ind	2,103

8. Two tracings accompany this report. One is a map showing the entire drainage basin of the Maumee River and its tributaries, and the other is a profile[1] of the river from Fort Wayne to Toledo.

9. The soil of the Maumee River Basin is glacial deposit over bedrock. The glacial deposit was originally composed of a clayey matrix, through which were scattered pebbles, bowlders, and angular pieces of all sizes. In some places the cementing material is separated from the sand, gravel, etc., but these areas are small in extent. In general the surface soil absorbs water very slowly. A large part of the area of the basin has been tiled for cultivation. For these reasons the surface run-off is comparatively great. The streams of this basin exhibit a considerable range between their high and low water flow.

10. Although the per cent of rainfall shed as surface run-off is comparatively great, the rate of discharge is not unusually large, on account of the flat surface of a large part of the drainage basin and the gentle slopes of the stream. These sections therefore shed their surface water slowly. The data available indicate a low maximum rate of discharge for the largest flood on record, as compared with the maximum rate of discharge of floods in other streams.

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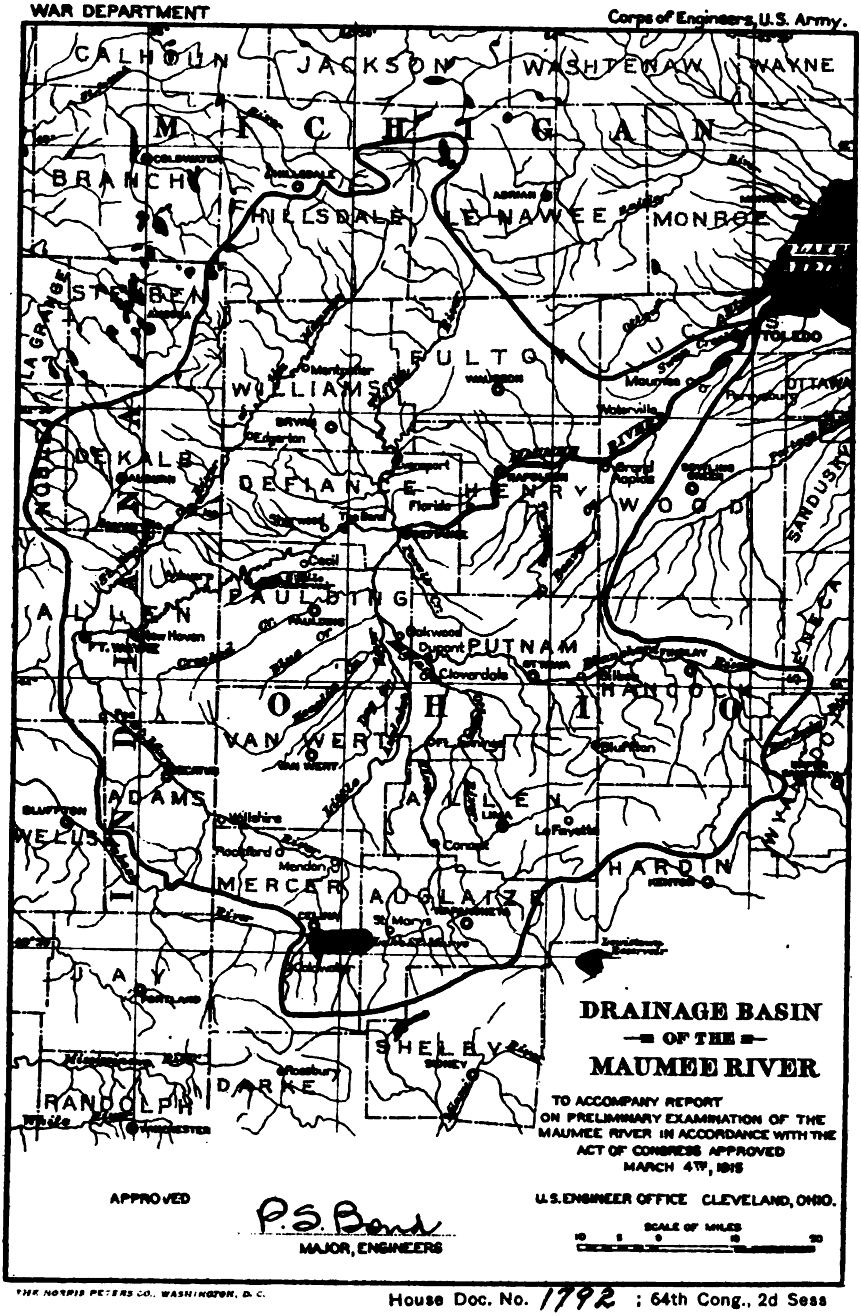
[1] Not printed.

WAR DEPARTMENT

Corps of Engineers, U.S. Army.



DRAINAGE BASIN
OF THE
MAUMEE RIVER

TO ACCOMPANY REPORT
ON PRELIMINARY EXAMINATION OF THE
MAUMEE RIVER IN ACCORDANCE WITH THE
ACT OF CONGRESS APPROVED
MARCH 4TH, 1915

U.S. ENGINEER OFFICE CLEVELAND, OHIO.

SCALE OF MILES
10 5 0 10 20

APPROVED

P. S. Bond
MAJOR, ENGINEERS

THE NORRIS PETERS CO., WASHINGTON, D. C.

11. The streams of this basin have, in general, eroded valleys of various depths in the glacial deposits, the stream itself occupying a channel through the bottom lands between the valley banks. The width of the valley varies, that of the Maumee River proper being about 1,000 to 2,000 feet wide about 11 miles below Fort Wayne, Ind., and increasing in width to about 2,000 to 4,000 feet near Toledo. A large per cent of the area in the valley is taken up by the river channel proper, which, 11 miles below Fort Wayne, is from 300 to 400 feet wide, increasing to 1,500 feet or more near Toledo. The channel of the river winds back and forth between the banks of its valley. In the Maumee River the most sinuous part is from a point about 11 miles below Fort Wayne to "the Bend," in Ohio. From the Bend to Defiance, Ohio, it gradually becomes less sinuous. Below Defiance it is fairly straight. In some places the river channel is not well defined. This is noticeably the case on the Maumee River from Fort Wayne to a point 11 miles below where the river occupies a single channel from 200 to 300 feet wide, with the top of its banks very little below the surrounding country.

12. The banks of the river channel, and in some places the river valley, are thickly overgrown with trees and underbrush which greatly retard the stream flow at flood stages.

13. Floods seldom overtop the valley banks, although they frequently overflow the bottom lands. The area which may be damaged by floods is therefore comparatively small.

14. Ice jams or gorges are of common occurrence, and on the lower Maumee, especially at Toledo, they have caused higher flood stages than those produced by any other cause.

15. In spite of the fact that these bottom lands are subject to floods, towns or parts of towns and cities have been built on them. This seems the more remarkable in view of the fact that there is no navigation on these streams except on the Maumee River at and below Toledo, Ohio, and higher ground, well beyond the reach of any flood, could readily have been obtained only a few hundred feet away. Since at maximum flood stages the river is not confined to its channel, but utilizes in addition a part of the valley, these buildings and structures reduce the available flood channel and tend to aggravate flood conditions at and above these points. Bridges built over the streams and their embankment approaches in some instances greatly reduce the available channel with a corresponding increase of local flood heights and current velocities. Flood conditions have been still further aggravated in some places by the filling in of the bottom lands and even by encroachments upon the low-stage river channel.

16. The destruction of the bridges has generally been due to the improper reduction of the flood channel. The rise of water in the towns, which has been aggravated by the bridges and by other encroachments upon the flood channel, has been practically the only damage caused to the towns by floods, as very few buildings have been destroyed or even carried from their foundations, and there is no trustworthy record of any loss of life due to floods in this basin.

17. Very little damage has been caused by erosion of cultivated lands and the deposit of unfertile material thereon. On the other hand, the periodical overflow of some of the bottom lands and deposit of fertile material thereon, makes these lands very productive.

As a whole, it seems that floods are a benefit rather than a detriment to these bottom lands, for, although crops are destroyed from time to time by the floods, the market value of these lands is as high as, or even higher than, that of adjacent lands which are not overflowed. Considerable material is at times deposited by floods in the navigable channel of Maumee River and Bay from Toledo to Lake Erie.

18. No previous examination has been made with a view to flood protection. Three examinations have been made with reference to navigation, as follows:

Section covered.	Congressional documents.				Annual Report Chief of Engineers.	
	House or Senate.	No.	Congress.	Session.	Year.	Page.
1. Lake Erie to Wabash River, Ind					1881	2348
2. Lake Erie to Defiance, Ohio, and south.	House	278	Fifty-fourth	First	1896	2973
3. Lake Erie to Fort Wayne, Ind	do	769	Sixty-second	Second		

1 and 3 contain maps.

19. The report of 1881 was on "Proposed ship canal from Toledo, Ohio, to the navigable waters of the Wabash River, and to the Ohio River at Cincinnati." The canals were found practicable, but no opinion was expressed as to the advisability of construction.

20. The report of 1896 was on "Survey for canal connecting the waters of Lake Erie with the Ohio River through the State of Ohio." It was unfavorable as to the particular project outlined by the act of Congress ordering the survey.

21. The last report was unfavorable to the improvement of the Maumee River from Toledo to Fort Wayne.

22. There is at present under consideration by a special board of officers of the Corps of Engineers a project (provided for by the river and harbor act approved July 25, 1912) for an artificial waterway from Lake Erie at or near Toledo, Ohio, to the southerly end of Lake Michigan, by way of the Maumee River and the city of Fort Wayne, Ind., or other practicable route. The survey has been completed and the report thereon is practically completed. A survey and estimates of cost have been made for a barge canal of practically the same dimensions as the New York State Barge Canal. It was thought that this waterway might serve as an extension of the New York State Barge Canal and permit through barge traffic from Chicago to New York. It is understood that the proposed plan for this waterway contemplates canalizing the Maumee River from Toledo, Ohio, to Fort Wayne, Ind., and may involve a consideration of the flood control of the river.

23. Works of improvement along the streams of this basin have been practically confined to the lower section of the Maumee River. Here the United States has dredged a channel from Lake Erie through Maumee Bay, 9 miles in length, and up the Maumee River past the city of Toledo to a point 7 miles above its mouth. The project providing for this channel, 400 feet wide and 23 feet deep,

has been completed. The total amount expended by the United States under this project to December 31, 1915, was $1,559,000.

24. The city of Toledo has expended about $300,000 for dredging and bulkhead construction in connection with navigation, and various private interests have expended about $400,000 for dredging, all in the vicinity of Toledo.

25. Levees have been constructed for local protection against floods of moderate height at Fort Wayne, Ind., and at Findlay, Ohio. Their cost is not known.

26. Two slack-water stretches in the Maumee River, aggregating 7½ miles in length, created by dams near Grand Rapids and below Defiance, form a part of the route of the Miami and Erie Canal, which extends from Toledo to the Ohio River at Cincinnati. These dams were constructed by the State of Ohio.

27. The Miami and Erie Canal follows close to the Maumee River from Toledo to Defiance. It locks out of Swan Creek, a tributary of the Maumee at Toledo, and almost immediately attains a height of 60 feet above the river in a flight of 8 locks. Thence for 20 miles is a level stretch to Grand Rapids, where the canal enters the Maumee River just above the dam in the river at that point. This dam is about 6 feet high and creates slack water in the Maumee for a distance of nearly 19 miles. The canal locks out of the river 1½ miles above the dam and follows the left bank at an elevation from 24 to 14 feet above the river to the dam below Defiance where it again enters the river. At Defiance, 6 miles above the dam, the canal locks out to an elevation of 50 feet above the river, and leaves the valley of the Maumee at that point. The dam below Defiance is about 14 feet high and causes slack water to that city. There is at present no navigation in the canal and its utility is solely to carry water for water-power development.

28. From Defiance to Fort Wayne, Ind., the old Wabash & Erie Canal parallels the Maumee River. This canal has long since been abandoned.

29. Commercial navigation has never existed on any of the rivers of the Maumee system, except in the lower section of the Maumee itself and the Miami & Erie Canal. This latter traffic apparently reached its maximum about 1851, six years after the completion of the canal (Report of the Chief of Engineers, 1896, p. 3044), and since then has steadily declined. Traffic on this part of the canal has now entirely ceased, the exact date of its disappearance being unknown.

30. The present commerce is confined to the dredged channel at Toledo Harbor. Certain sand dredges, with a draft of 5 feet, reach sand deposits in the river 3 or 4 miles above this section. The commerce of Toledo Harbor is large and increasing. The following statement shows its amount for the five calendar years, 1910–1914, inclusive:

Year.	Receipts.[1]	Shipments.[1]	Total.[1]	Value.
1910	1,846,953	4,673,439	6,520,392	$20,867,623
1911	959,117	5,448,761	6,407,878	19,017,281
1912	2,182,943	4,755,411	6,938,354	25,280,674
1913	1,797,413	5,713,221	7,510,634	25,355,100
1914	1,299,221	5,866,951	7,166,172	22,286,168

[1] Short tons.

31. Toledo Harbor affords the only prospective commerce, unless the proposed waterway between Lake Erie and Lake Michigan, now under consideration, as before mentioned, should be constructed, in which case the Maumee River would probably form the western link of the waterway from Fort Wayne to Toledo.

32. In the present investigation it has not been practicable to obtain reliable data concerning the frequency of floods and the damage caused thereby. Apparently no consistent record of floods has been kept, and very little attention was given to them before the disastrous flood of 1913 caused a general awakening in this section of the country.

33. Reports have been received that abnormal floods occurred at Fort Wayne, Ind., in 1904, height 20.5 feet; 1908, height 21.5 feet; and 1913, height 25 feet; in Lucas County, Ohio (near Toledo), in 1904, 1907, and 1913; at Ottawa, Ohio, in 1883, 1903, and 1913; in Wood County, Ohio, 1904 (caused by ice jam) and 1913; at Findlay, Ohio, in 1883, 1904, 1905, 1913, and 1915; and at Lima, Ohio, in 1913 and 1915.

34. Prof. W. K. Hatt, in his report on Flood Protection in Indiana, published by the Indiana Bureau of Legislative Information, Bulletin No. 4, December, 1914, gives data showing that the average interval between Indiana floods of great magnitude is six and one-fourth years. He also gives data on precipitation which would indicate that the average period between the most intense floods would be about 34 years.

35. There is not sufficient data at hand to determine whether or not the above frequencies apply to floods in the Maumee system. Since the State of Indiana is so near the Maumee Basin and contains part of it, it is probable that they do apply. The flood of 1913 seems to be the only one of record which caused any considerable damage.

36. This flood of March, 1913, caused the greatest flood heights on record in this basin, except those on the lower Maumee resulting from ice gorges, the water being from 2 to 5 feet higher than previously known. This may have been due in part to a greater discharge, but unquestionably the flood heights were increased to a great extent by the encroachments on the flood channel hereinbefore referred to, and it is possible that the volume of water was no greater than that of 1883 or some other former floods.

37. The flood of March, 1913, was caused by heavy rainfall during the period March 23–27, inclusive. Melting snow and ice played a small part in this flood. The rainfall record, in inches, of the basins of the four large tributaries was as follows:

Watershed.	March—					Total.	
	23	24	25	26	27	3 days.	5 days
St. Joseph	0.97	2.10	1.55	0.065	0.315	4.62	5.00
St. Marys	2.18	2.07	2.88	.82	.25	7.13	8.20
Auglaize	2.32	1.43	2.82	.38	.35	6.57	7.30
Tiffin	1.96	.97	1.57	.16	.47	4.50	5.13
Maumee above Defiance	2.45	.85	2.50	.12	.55	5.80	6.47
Maumee below Defiance	2.08	1.52	1.74	.36	.22	5.34	5.92
Average, weighted for areas	2.00	1.57	2.29	.34	.34	5.86	6.54

38. The heaviest rainfall was in the St. Marys and the Auglaize basins, and the greatest floods were on these two streams. The ground was not frozen but had been saturated by previous rains, and so did not offer means of storing any considerable additional amount of water.

39. The discharge of the St. Marys River at Fort Wayne has been estimated at 30,000 second-feet (including 9,000 second-feet which overflowed into the Wabash River and 6,000 second-feet which overflowed into the Maumee River at New Haven, Ind.) and of the St. Joseph River at 12,000 second-feet. The discharge of the Maumee at Fort Wayne was estimated at 27,000 second-feet; at Sherwood, Ohio, a few miles above the junction of the Tiffin and Auglaize Rivers, 28,000 second-feet; and at Waterville, Ohio, about 20 miles above the mouth of the river, 125,000 second-feet. These estimates of the discharge were made soon after the flood in connection with a plan for flood protection for the city of Fort Wayne, and were later roughly checked. The estimates of the discharge at Sherwood and Waterville were obtained from gauge discharge curves constructed from data obtained by stream measurements, but as no very high stages of the river occurred while the stream measurements were in progress, the estimates may be in error. The values given are much less than would be obtained by use of most formulas for maximum flood discharge but are believed to be approximately correct.

40. The damages caused by floods prior to 1913 seem to have been very small. The greater amount of damage caused by the 1913 flood was undoubtedly due to the fact that sections of towns, bridge approaches, bridges with insufficient openings, and other encroachments on the flood channel had been constructed which did not exist in any former flood of great magnitude.

41. An estimate of the damages caused by the 1913 flood and by former floods for which data could be obtained by the present investigation is as follows:

Flood of 1913.

Locality	Urban.	Rural.	Railroads.	Remarks.
Henry County, Ohio	$5,000	$30,000	$1,000	Population, Napoleon, 5,000.
Findlay, Ohio (Hancock County).	60,000			Population, Findlay, 10,000; three-fifths of town flooded; no damage from high velocities.
Fulton County, Ohio		25,000		Mostly bridges.
Wood County, Ohio	10,000	20,000		
Ottawa, Putnam County, Ohio	100,000			Population, 2,800; practically entire town flooded; no damage due to high velocities.
Lucas County, Ohio		55,000		
Williams County, Ohio	1,000	10,000	2,000	
Fort Wayne, Allen County, Ind.	1,000,000			Population, 1910, was 63,000; part of town flooded; very little current.
Adams County, Ind.	(1)	(1)	(1)	
Lima, Allen County, Ohio[2]	235,000			Population, 30,508.
Oakwood, Paulding County, Ohio.[2]	92,000			Population, 600.
Defiance, Defiance County, Ohio.	450,000			Population, 7,327.
Total	1,953,000	140,000	3,000	

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[1] No record.

[2] From correspondence of board of officers on river floods. All other information from city and county engineers.

Floods prior to 1913.

Locality.	Damage.	Remarks.
Henry County, Ohio	Not over $5,000 in 1 year, say $50,000.	Danger stage is passed almost every year, but damage is always very light.
Findlay	No record	Floods in 1883, 1904, 1905, and 1913.
Hancock County, Ohio		No record kept. Damage small, except in 1913.
Fulton County, Ohio	No record	No record of any dangerous floods except in 1913.
Wood County, Ohio	$90,000	Caused by flood from ice jam in 1904, which destroyed 3 spans, 300 feet long, of wagon bridge. No other records of floods above danger stage.
Ottawa, Putnam County, Ohio.	Not over $50,000	Floods in 1883 and 1903. Damage not very great and only to residence sections, except 1913 flood.
Lucas County, Ohio	Year 1907, $20,000	Floods in 1904 and 1907. Height 20 feet above low-water stage.
Williams County, Ohio	No record	No record.
Fort Wayne, Allen County, Ind.	$1,000	Floods in 1904, 1908, and 1913. Damage small except in 1913.
Adams County, Ind.	No record	No record
Total	$211,000	

42. There was a flood of considerable magnitude on the Ottawa and Blanchard Rivers in July, 1915, with crest 15 inches lower at Lima, Ohio, than in 1913. Coming so late in the season the streams were obstructed by a heavy growth of weeds and brush, greatly retarding the flow. Damage at Lima was not over $25,000. There was considerably greater damage to growing crops. In many cases wheat, which had been harvested, was carried away.

43. The above data, even for the 1913 flood, are not complete, and the information as to prior floods is fragmentary. There are 14 counties in Ohio, 3 in Indiana, and 2 in Michigan in the Maumee Basin which may be affected by floods. Requests for information were made of the engineers of all these counties and of the city engineers of the most important cities of the Maumee Basin, both in Ohio and Indiana. The counties in Michigan were omitted, as they are on the headwaters of the St. Joseph and Tiffin Rivers and were not considered as subject to disastrous floods. From only 9 of the 17 counties in Ohio and Indiana was any information received. This information was supplemented by data concerning cities or towns in 3 more of these counties taken from correspondence of the board of officers on river floods. The counties from which no data were obtained are Van Wert, Mercer, Auglaize, and Marion Counties, Ohio, all on the headwaters of the St. Marys and Auglaize Rivers, and Dekalb County, Ind., on the St. Joseph River, which was little affected by the 1913 flood. It is, however, considered probable that the most serious damage caused by the 1913 flood has been reported, as information has been received of the damage caused to all the cities or towns most seriously affected. The estimate of the damage caused to some of the cities has probably been somewhat exaggerated. The estimate for Fort Wayne, for example, was placed at $1,000,000. Practically the only damage done at Fort Wayne was that due to the wetting of property. A large part of the residence section of the town was under water, but there was very little current and only one house carried from its foundation. There were no deaths. It is probable that the total damage caused by the 1913 flood to all the urban districts in the basin did not exceed $1,000,000.

44. Information of the damage caused to rural districts was obtained from only 5 of the 17 counties. These counties were probably the ones most seriously affected. The average reported damage in the five counties from which information was obtained was $28,000. Considering all of the remaining counties equally affected, the total damage to the rural districts would be only $475,000.

45. Very little information was received concerning the damage caused to railroads by the 1913 flood. A total estimate of only $3,000 in two counties was received. Possibly $50,000 would cover this damage.

46. The records of the city and county engineers, which include various periods, varying from 1883 to 1904 to date, give a total estimate of only $211,000 as the damage caused by floods prior to the 1913 flood. All evidence indicates that damages caused by those earlier floods were very slight.

47. The communities most seriously affected by the flood of March, 1913, were visited by the district engineer officer at Cleveland, Ohio, shortly after the flood, and local conditions were noted. Following are abstracts of reports submitted by him relative to conditions at the places named:

48. *Fort Wayne, Ind.*—This city is located at the junction of the St. Marys and St. Joseph Rivers, which unite to form the Maumee River. Population, 1910, 63,000. The St. Joseph was not in flood. High water in that basin was caused by the St. Marys River. The water was 3½ feet higher than previous high water of March, 1908. This extra height caused most of the damage.

49. The east bank of the St. Joseph is protected by a levee against ordinary high water. This levee broke, flooding portions of the city east of the St. Joseph and north of the Maumee. The Maumee River within the city limits is crossed by three bridges, which were not damaged. The city is protected against the Maumee by levees, in which one breach occurred near Coombs Street Bridge, through which the overflow from the St. Joseph passed into the Maumee.

50. The Maumee River below the city limits overflowed farm lands on both sides. At New Haven, 5 miles below the city, is a highway bridge of two spans, each 170 feet long, contracting the flood section. The water rose nearly to the floor level of the bridge, said to be 6 feet higher than any previously recorded flood. Shortly below this bridge the flood section is still more contracted by the Wabash Railway bridge of two spans, each of 210 feet, and embankment. The water rose to within 18 inches of the rails. This embankment crosses the valley of the Maumee and during the flood caused water 2 feet higher on the upstream than on the downstream side.

51. Near New Haven and above the Wabash embankment a natural drainage channel connects the St. Marys River with the Maumee, at a point 6 miles above the city. The summit level of this channel is 6 feet lower than the high-water level of this flood, which resulted in a diversion of a portion of the flow of the St. Marys around the city.

52. The St. Marys River within the city is crossed by numerous bridges, none of which was injured. The flood section generally is decreased by unauthorized fillings, bridge piers, and abutments. The channel is crooked, of slight depth, and further obstructed in the lower part by islands, on which willow trees are beginning to grow.

These obstructions are particularly noticeable near the junction with the St. Joseph, where the stream has been deflected by a dike, narrowing the channel and causing it to enter the St. Joseph at right angles. Along the stream are several railroad embankments, generally parallel to it and reducing the flood section. Across the river, opposite the central part of the city, is a high embankment of the Pennsylvania Railway, encroaching seriously upon the flood section and having only two bridge openings, each about 55 feet long. This embankment held back the flood, causing a difference in elevation on its two sides of 10 inches. It is located near the summit level, or divide, between the St. Marys Basin and that of the Wabash. Water flowed westward across this summit level into the Wabash system. The St. Marys River overflowed both banks quietly, with no noticeable current, but one house in the entire city being moved from its foundation.

53. Remedies suggested: Diversion of part of flood waters of St. Marys into the Maumee through the before-mentioned natural high-water channel; increasing discharge section of the Maumee at New Haven by replacing a portion of the Wabash embankment by open construction; raising the levee on the east bank of the St. Joseph and restoring flood section of the St. Marys by straightening, widening, and deepening the high-water channel, and increasing bridge openings now too contracted.

54. A possible diversion of part of the St. Marys into the Wabash system is deemed inadvisable, as the Wabash can not safely carry its present discharge.

55. *Defiance, Ohio.*—This city is located at the junction of the Maumee and Auglaize Rivers. The Tiffin River empties into the Maumee from the north opposite the upper part of the town. Population about 7,000. Flood damage stated to be about $450,000. The main part of the town is on high ground. Only a comparatively narrow strip in the town proper was flooded. The Auglaize was at a higher stage than the Maumee, and thus prevented excessive current in the latter above its junction with the Auglaize, so that damage along the Maumee on either side was mainly due to backwater. The Auglaize was about 26 feet above low water, 8 to 10 feet above any previous known flood.

56. The Maumee is crossed just above the junction with the Auglaize by the Wabash Railroad bridge, State bridge, and county bridge. The State bridge, a light structure built as a continuation of the tow path of the Miami and Erie Canal, was pushed off its piers by the accumulation of drift against it. The other two bridges were not damaged, although the water was 6 inches over the floor of the county bridge. Discharge section at the Wabash Bridge is apparently ample. The Auglaize in this vicinity is crossed by three county bridges and by the Baltimore & Ohio Railroad bridge, at each of which the discharge section is unduly restricted. One county bridge, at the foot of Hopkins Street, was carried away and the center pier overturned. The other bridges were not damaged, although the water rose over their floors.

57. the Baltimore & Ohio Railroad embankment served as a dike to hold back water which passing through the grade opening at Francis Street rushed with great velocity down that street, flooded and damaged buildings on the low ground between the street and the

river, carried away the Hopkins Street county bridge and out across the projecting point at the junction of the rivers, where it carried away a number of low sheds on low ground adjacent to the river. On the north side of the Maumee opposite the mouth of the Auglaize, the swift current from the latter damaged several sawmills and lumber yards.

58. A power dam on the Auglaize, 2½ miles above this city, failed before the flood reached its maximum. This dam, about 30 feet high, is said to have formed a pool at low water extending to Oakwood, 14 miles above.

59. Remedies suggested: Restoration of full discharge section for the Auglaize and increase in section of the Maumee below the junction. The northern part of the city proper might be protected by levees of moderate height, but the value of the low land east of the Auglaize would hardly justify the cost of building levees of such height and section as would be necessary to protect them from overflow.

60. *Napoleon, Ohio.*—This town is situated on the Maumee River about 35 miles above Toledo. Population about 5,000. During the 1913 flood about 30 houses were flooded; damage not to exceed $15,000. Water level highest on record, 24 feet 5 inches above low water, 4 feet higher than usual spring floods. Two bridges at and near the town suffered a slight damage to flooring. The city is located on high ground and only a comparatively narrow strip of land adjacent to the river was flooded. There was very little current in the flooded portion, the damage being due to high water alone.

61. Construction of a levee of moderate height along the banks of the river would apparently prevent further damage, but value of property so protected is hardly commensurate with the cost.

62. *Oakwood, Ohio.*—This town is located on the Auglaize River, 17 miles above Defiance. Population, 600. Damage estimated at $92,000, the whole town being overflowed. Flood stage said to be 6 feet higher than that of 1883. There are two bridges near the upper part of the town. The county bridge at Walnut Street, with two spans 125 feet each and two approach spans of 50 feet each, was carried away. The New York, Chicago & St. Louis Railroad (Nickel Plate) crosses the valley on a high embankment. The bridge over the river has two spans aggregating 275 feet in length. Just below a grade crossing at First Street considerable damage was done by swift current.

63. The Auglaize Power Co.'s dam, 14 miles below the town, is reported by the county engineer to have had 13 feet of water on the spillway at the time the dam gave way. The crest of the flood was reported to have been 28 feet above ordinary low-water level. The railroad embankment is stated to have caused a difference in level of about 2 feet and is regarded as responsible for the damage along First Street.

64. Remedies suggested: Replacing part of railroad embankment with open construction and increasing capacity of spillway at the dam.

65. *Ottawa, Ohio.*—This town is located on the Blanchard River 20 miles below Findlay, Ohio, in a large, irregular bend of the river. Population, about 2,800. The river is very tortuous. Practically

the entire town was flooded; damage estimated at not to exceed $200,000. The river flows from east to west.

66. The valley of the Blanchard is crossed by the bridge and embankment of the Detroit, Toledo & Ironton Railroad at the extreme eastern (upstream) limits of the town. This embankment served to protect the town and was in the nature of a benefit to this locality, but it greatly retarded flow and must have been a detriment to points above. Lower down is Oak Street Bridge, which was entirely covered by water, but not damaged. Below this is the Cincinnati, Hamilton & Dayton Railroad bridge, where the flood section is greatly reduced by earth embankment approaches. This obstruction backed up the water and caused overflow to a depth of 4 feet in the section of the town between the two embankments. This overflow followed the low ground, discharging into the Tawa River, which empties into the Blanchard below the town. Two bridges below the Cincinnati, Hamilton & Dayton Railroad bridge did not seriously obstruct the flow, the approaches being considerably lower than the bridge floors. Farther downstream the river valley is crossed by the embankment and bridge of the Findlay & Fort Wayne Branch of the Cincinnati, Hamilton & Dayton Railroad, greatly reducing the flood section, and which backed up the water, causing overflow of the remaining sections of the town.

67. Remedies suggested: Replacing part of the Cincinnati, Hamilton & Dayton Railroad embankment by open construction and possibly raising grade of bridge; straightening river in the vicinity of the Findlay & Fort Wayne Railroad and providing new bridge to afford greater cross section. Conditions would be improved by cutting off the large bend in the river in the northwestern part of the city.

68. *Findlay, Ohio.*—This town is located on the Blanchard River, a tributary of the Auglaize. Population, about 10,000. About three-fifths of the city was flooded. Owing to the slight current, the damage was not as serious as at other places.

69. There is a dam 8½ feet high below the city which creates slack water for the use of pleasure craft. There is also a dam 8 feet high above the city, formerly used for water-supply purposes. The river is crossed by railroad bridges with clear spans, as follows:

	Feet.
Cleveland, Cincinnati, Chicago & St. Louis Railroad	244
Toledo & Ohio Central Railroad	146
Lake Shore Electric Railroad	158
Lake Erie & Western Railroad	135

At one time during the flood the water was said to have been 4 or 5 feet higher on the upstream side of the Toledo & Ohio Central Railroad bridge than on the downstream side. Later this difference decreased to 4 inches. At the Lake Erie & Western Railroad bridge a difference of 14 inches existed. The river is tortuous and the banks below the city filled in at various points, restricting the cross sections. Just above Corey Street Bridge the corner of the old building formerly used as a power house encroaches some 30 feet on the channel, diminishing the available discharge section still more. Some distance above this point buildings comprising half a block have been built on a fill in the old stream bed. Below the lower dam the river is particularly crooked and filled with obstructions. Below Broad Street Bridge a levee had been built so as to materially decrease the cross section. Farther below this point the river appeared to be of normal width. Eagle Creek, a tributary of the Blanchard, is also unduly contracted and obstructed by several bridges of short span.

70. Suggested remedies: Widening spans of bridges or providing open approaches, cutting off projecting points, and straightening and widening the river below the lower dam.

71. *Lima, Ohio.*—This town is located on the Ottawa River near its headwaters. Population, 30,508. Damage to Lima and the county is stated to be about $235,000. The water in the upper part of the town was 1½ feet higher and in the lower part near the Erie Railroad embankment 3 feet higher than ever before. The damage was mostly due to overflow, limited to a strip two blocks wide on either side of the river. The river has a rocky bottom and is crossed by numerous bridges with spans of 75 to 95 feet and clearances of 12 to 16 feet above rock. One bridge was destroyed. The water rose over all bridges but one, causing no damage.

72. In the upper part of the city the river valley is crossed by an embankment of the Pennsylvania Railroad. Two concrete arches cross the river, each 35 feet span and 23 feet clearance. The water rose to within 2 feet of the crown of the arches, and at about the same level on each side of the embankment. The Detroit, Toledo & Ironton Railroad crosses on a pile bridge, which offers no obstruction. The Cincinnati, Hamilton & Dayton Railroad has two 75-foot spans, which is an ample section. Collet Street Bridge is a new one of concrete construction with two 60-foot spans. It carried most of the flood water, a part passing around over low ground. Below the city the Erie Railroad embankment crosses the valley with two spans over the river, one 71 feet wide and the other 56 feet wide. This embankment was responsible for high water in the lower part of the city.

73. In general, the flood section has been reduced by unauthorized filling, by buildings, and by insufficient bridge spans, and should be restored to proper width. The opening in the Erie Railroad embankment is too narrow and should be enlarged. The river below this embankment is crooked and might profitably be straightened and enlarged.

74. *Toledo, Ohio.*—This town is located on the Maumee River near its mouth. Population in 1910, 168,000 Damage in 1913 flood was slight. Much greater flood heights have been reached in former years when ice gorges held back the water. Flood heights in 1913 at several points were:

Locality.	Distance above mouth of river.	Flood height above mean lake level.	Remarks.
	Miles.	*Feet.*	
Mouth of river	0.0	1.9	Lake level high; northeast wind.
Madison Avenue	4.5	8.45	Above Cherry Street Bridge.
City waterworks	8	11.3	

The water was 1.5 feet higher above Cherry Street Bridge than below it, due to temporary conditions at the site, where a new bridge was under construction, and the piers of both the old and new bridges, cofferdams, and a number of piles seriously obstructed the flow. At the present time conditions are much better than in 1913, due to better section at Cherry Street Bridge and to the completion of the channel to project depth of 23 feet instead of 21 feet, as in 1913.

75. There is good reason to believe that any future flood which is not accompanied by an ice gorge will cause little trouble at Toledo. The really high water at Toledo has been caused by ice gorges. In the 1883 flood an ice gorge formed at the mouth of the river and backed up the water to such an extent that the flood height at Madison Avenue was 14.6 feet above mean lake level. This is almost twice as high as the 1913 flood. The last serious ice gorge was in 1904. These gorges form primarily at the mouth of the river, where the ice running down the river encounters the still ice in the bay. The ice in 1904 packed solid to the bottom of the channel. This occurs opposite a point called Presque Isle, where there is an angle in the channel. After the primary gorge forms, secondary gorges are created at several points in the river, usually year after year at the same places, and where the river is wide and, except in the channel, shallow. It is noteworthy that at the narrowest part, which is at the Lake Shore & Michigan Southern (New York Central Railroad) bridge, with a sharp bend in the river just above, it is reported that no gorge formed.

76. Conditions at the mouth of the river are better than in the past, so far as the tendency to gorge is concerned. The channel in the river just above that point was only 200 feet wide in 1904, and 21 feet deep. At present it is 400 feet wide and 23 feet deep. The channel through the bay has been completed to 23 feet depth. A conjunction of bad ice conditions with very high run-off has been much feared, but, on the other hand, the high velocity accompanying maximum discharge has a tendency to prevent the gorge formation. Should the channel at some future time be still further widened at the junction of bay and river opposite Presque Isle by cutting off the point on the easterly side, the effect would be both in the interest of navigation and also decrease the probability of ice gorges.

77. At various points in the Maumee River, other than Toledo, higher water than that of March, 1913, has been caused by ice gorges.

78. The Maumee River during floods is continually depositing more or less material in the navigable channel of the river from Toledo to the lake which from time to time has to be removed, the estimated cost of maintenance dredging being $35,000 per annum, part of which, however, is necessary because of deposits in the dredged channel resulting from storms in the lake. From turbidity observations of the water and from estimates of the volume of water which passed Toledo during the 1913 flood it is roughly estimated that there was carried down past the city water works of Toledo from March 24 to 31, inclusive, at least 4,000,000 cubic yards of sediment. Only part of this, however, settled in the navigable channel. The section most affected was that in Maumee Bay, just below the mouth of the river. The average fill throughout the inner division (first 2 miles) of the bay channel was at least 1 foot, which would amount to 157,000

cubic yards in a section 2 miles long. Material is deposited in the channel not only by large floods but also by smaller ones.

79. Interruption of traffic because of flood conditions has been negligible. The only traffic is that at Toledo Harbor. The opening of navigation on the Great Lakes generally comes later in the season than the usual spring floods. Velocities high enough to seriously interfere with the operation of vessels are rarely noted at Toledo during the season of navigation. No damage to works in aid of navigation, other than silting of the channel, has occurred.

80. During the 1913 flood practically all the damage on the upper Maumee River and on the St. Marys and St. Joseph Rivers was at Fort Wayne, Ind. At this point, especially on the St. Marys River, where the worst flood occurred, the original flood channel had been encroached upon until only a fraction of the original channel remained. To protect this town by detention or storage reservoirs the following would be required:

81. The flood height would have to be reduced about 4 feet. Considering the estimates of discharge herein given as correct, the remaining capacity of the St. Marys River would be about 12,000 second-feet and that of the Maumee, at Columbia Street Bridge, about 21,000 second-feet. The St. Joseph River could then discharge only 9,000 second-feet as a maximum. The 1913 flood at this place was for about five and one-half days above the allowable height or danger stage (4 feet lower than maximum). The excess rate of discharge on the St. Marys was 18,000 second-feet and on the St. Joseph 3,000 second-feet. The discharge to be held back would therefore be about 4 billion cubic feet on the St. Marys and about 650 million cubic feet on the St. Joseph. The above estimates are only approximations and are not based on reliable data. It is believed that they are not too small. To provide for a proper factor of safety, about 25 per cent will be added. The water to be held back becomes 5 billion cubic feet on the St. Marys and 800 million cubic feet on the St. Joseph.

82. To provide storage for this water over and above the natural storage of the river in the allowable height of flood will require numerous reservoirs of small capacity. Detention reservoirs (not including the cost of flooded lands) will cost between $500 and $1,000 per million cubic feet, and storage reservoirs (including cost of flooded land) between $1,000 and $1,500 per million cubic feet. Assuming $500 for detention reservoirs and $1,000 for storage reservoirs, the cost of protection by these methods would not be less than the following:

	Detention.	Storage.
With no factor of safety for estimate of discharge:		
St. Marys River	$2,000,000	$4,000,000
St. Joseph River	320,000	640,000
Total	2,320,000	4,640,000
With factor of safety of 25 per cent for error in estimates of discharge:		
St. Marys River	2,500,000	5,000,000
St. Joseph River	400,000	800,000
Total	2,900,000	5,800,000

83. This would provide for a flood equal to that of 1913. Other floods will not be exactly similar to the 1913 flood. Should the heaviest rain fall on the St. Joseph River instead of on the St. Marys and with corresponding intensities equal to those of the 1913 flood, the probable discharge on the St. Joseph River would be about 31,000 second-feet, and on the St. Marys about 15,000 second-feet. To provide for this contingency the above detention reservoirs on the St. Marys would be sufficient, but those on the St. Joseph would be far too small. Those on the St. Joseph would require a net capacity of 5,000,000,000 cubic feet, and adding 25 per cent for error in estimate, six and one-fourth billion cubic feet. To provide for both these contingencies with a factor of safety of only 25 per cent on estimates of discharge, the cost would be not less than:

	Detention.	Storage.
St. Marys River	$2,500,000	$5,000,000
St. Joseph River	3,020,000	6,040,000
Total	5,520,000	11,040,000

84. The total rainfall of the 1913 flood, March 23 to 27, inclusive, on the St. Marys River was 8.2 inches and on the St. Joseph River 5 inches. During this same flood there were sections of the country as large as both the drainage basins of these two rivers upon which the total rainfall was 10 inches. A more intense rainfall on either or both of these drainage areas is entirely possible. To increase the estimated discharges of the 1913 flood by 25 per cent for probable greater rainfall would be only reasonable. This makes a total increase of 50 per cent. Under this assumption the total costs for detention reservoirs would be not less than $6,625,000 and for storage reservoirs $13,200,000.

85. Practically the only benefit to be derived from these reservoirs would be the protection of Fort Wayne from floods. No serious damage above Fort Wayne, either on the St. Marys or St. Joseph, has been reported. There are no towns on the Maumee River between Fort Wayne and Defiance, Ohio, which require protection. The influence of these reservoirs would be felt very little on the Maumee River just above its junction with the Tiffin and the Auglaize, since at present the rate of flood discharge is very much reduced in the section between Fort Wayne and Defiance, which receives no large tributary and which has very great flood overflow, much of which would be lost if the rate at Fort Wayne were reduced. Below this point its influence would probably not be felt at all during large floods which cause heights above the danger stage, for the greatest intensity of the flood in this section comes from the Auglaize and Tiffin Rivers, which, on account of their shorter distance from the section, would ordinarily send their flood peak in advance of that from the upper river. Exceptional combinations may be conceived in which this reservoir system may cause either higher or lower floods in this section. It is considered that its benefits on the lower Maumee at and below Defiance are negligible.

86. To obtain reservoir sites on the St. Marys and St. Joseph Rivers for the enormous amount of storage required by these methods

would be very difficult. Storage reservoir sites with capacities of from eight hundred and seventy million to one and one-half billion cubic feet can be found, but a large part of this capacity is already utilized by the stream as its flood channel for the discharge rate which the reservoirs would establish.

87. In the estimate for detention reservoirs the value of the land which would be flooded was not considered. While the material deposited on this land would probably fertilize it and the benefits derived therefrom may compensate the damages caused by the flooding of same, it is not probable that this land could be utilized for this purpose without the payment of heavy damages. This would increase the estimated cost for detention reservoirs given above.

88. The estimate of $1,000,000 damage caused by the 1913 flood at Fort Wayne is probably much too great. Assuming the cost of storage reservoirs for this section at approximately $11,000,000, the interest on the investment alone for a period of six years at 3 per cent would amount to $2,000,000, which is considerably in excess of the probable damage to be averted during this period. This also takes no account of the economic loss of fertile territory resulting from the construction of the reservoirs. But even if the benefits equaled the cost, the system would not be justifiable if equal protection could be provided at less cost.

89. Immediately after the flood of 1913 Fort Wayne prepared plans for flood protection by means of channel improvement. Two plans were considered. One of these provided for opening up and maintaining the original channel of the streams in order to give them sufficient capacity to accommodate floods. This was estimated to cost $1,524,000. The other plan provided for improving the original channels sufficiently to take care of only part of the maximum flood discharge and to supplement the St. Marys channel with an additional cut-off flood channel. This was estimated to cost $1,226,000. The latter plan has been adopted. It appears that in these plans no allowance has been made for an error in estimating the discharge of the 1913 flood. Nor has any allowance been made for a probable heavier average rainfall over the area. Both of these are possible. Even were a factor of safety of 50 per cent allowed in the estimates of the discharge, the cost of flood protection by channel improvement would probably not exceed one-fourth the cost of protection by detention reservoirs and one-eighth the cost by storage reservoirs.

90. It is considered, therefore, that the use of detention or storage reservoirs as a means of flood protection on the upper Maumee and on the St. Marys and St. Joseph Rivers, and for the effects which they may have on floods on the lower Maumee River does not appear to be economical.

91. Definite information as to flood heights and flood discharge on the Tiffin and Auglaize Rivers is lacking, which prevents a reliable comparison of the application of the two general methods of flood protection on these two streams. The section on the Tiffin River was not seriously damaged by floods in 1913. There seems to be no reason why it may not be seriously damaged in the future. Some of the towns on the Auglaize and its tributaries were seriously damaged by flooding during the 1913 flood, and further damage is again reported

(July, 1915). The total estimated damage to all these towns, however, was not over $482,000 (not including Defiance, where damage was estimated at $450,000) on both Maumee and Auglaize. If the damage to towns on the lower Maumee be added, the total comes to $952,000 for towns which would be affected by improvement by detention or storage reservoirs on the Auglaize. The drainage area of the Auglaize is 2,461 square miles. That of the St. Marys and St. Joseph Rivers combined is 2,103 square miles. It is known that the maximum rate of flood discharge during the 1913 flood was much greater on the Auglaize than the combined maximum discharge of the St. Marys and St. Joseph Rivers. It is also known that a greater reduction of flood height will be required to protect some of the towns on this river than was considered necessary at Fort Wayne. In some cases in the Auglaize Valley it appears that the water rose to 10 feet above the danger stage, as compared with 4 feet at Fort Wayne. It is only reasonable to suppose that a general plan of flood protection by means of detention or storage reservoirs would cost more for the Auglaize system than for the St. Marys and St. Joseph Rivers combined. Such an expense would hardly seem advisable for the prevention of such a small amount of damage. It is possible that detention or storage reservoirs may give more favorable results for local sections in the headwaters of this stream (Auglaize). A very large reduction in the rate of flood discharge of the Auglaize will no doubt improve flood conditions on the lower Maumee, while it is probable that only a small reduction, which would result from only local use of detention reservoirs, would have a tendency to hold back the peak of the flood from the Auglaize and might cause it, under certain conditions, to unite with that from the upper Maumee and thereby increase flood heights on the lower Maumee.

92. The evidence clearly indicates that flood conditions in the towns affected by the 1913 flood were very much aggravated by obstructions placed in the flood channels, and these can undoubtedly be greatly ameliorated by means of local channel improvements. Several of the affected towns have already considered local plans of this nature.

93. On the lower Maumee the most serious floods are caused by ice gorges. Detention and storage reservoirs would have no effect on these. These floods can probably best be prevented by local diligence and precautions and local channel improvement.

94. The only serious effect of floods upon present navigation is the deposit of sediment in the navigable channel from Toledo, Ohio, to Lake Erie. Detention and storage reservoirs may have a tendency to reduce the turbidity of flood waters and thereby reduce the volume of sediment brought down by the river. On the other hand, they would reduce the rate of flood discharge and prolong its duration, thereby reducing its scouring effect and increasing the time during which deposit by the flood would be made. Flood protection for the localities above the head of navigation by means of local channel improvements would have no appreciable effect upon present navigation. On the other hand, the dredging of the navigable channel has had a beneficial effect upon flood conditions at Toledo, both during floods caused by very heavy discharge and during floods caused by ice gorges at the mouth of the river.

95. There is at present a water-power plant on the Auglaize River a short distance above Defiance, Ohio. Other water-power plants draw water from the Miami and Erie Canal between Defiance, Ohio, and Toledo, Ohio. There are no other water-power developments in the Maumee Basin. The streams are not well adapted to water-power development. Should the proposed Lake Erie-Lake Michigan waterway be constructed, water will be available at the dams on the Maumee for the development of a considerable amount of power.

96. From the foregoing it seems that the method of local channel improvement is the best general plan of flood protection for the upper Maumee, the St. Marys, and the St. Joseph Rivers. It seems very probable that the method of local channel improvement will be the best for the remainder of the system, with a possibility of detention reservoirs for local improvement in the headwaters of the Auglaize.

97. It is not evident that any flood protection plans which may be adopted for the Maumee River Basin will produce such benefits to navigation as would justify the United States in cooperating with the States and other communities and interests unless the waterway from Lake Erie to Lake Michigan should be established, in which case there might be some ground for cooperation.

98. The board concludes therefore that, basing action on the value of protection to navigation alone, the United States is not warranted in cooperating with the States and other communities and interests in devising or carrying out plans for flood protection on this stream.

99. The board in expressing the foregoing conclusion does not wish to be understood as attempting to minimize the flood problem on the Maumee River and its tributaries; nor as opposing participation on the part of the Federal Government in the problem of flood protection on these streams.

The Federal Government, through the Weather Bureau and other agencies, is already engaged in the collection and publication of information and data which will be of great value in the final solution of the flood problem. A further reduction in flood damage can, in the opinion of the board, be secured through the agency of the United States by the extension of the authority of the Federal Government so as to give it control over streams in the interest of flood protection, similar to that provided in the interest of navigation by the act approved March 3, 1899. Control over waterways in the interest of navigation has been limited to those channels susceptible of actual navigation, and to a certain extent to an indeterminate area beyond, within which area control over the tributaries is necessary to the proper protection of navigation in the main channels. Control over waterways in the interest of flood protection must of necessity include practically the whole stream and its tributaries without any limitations imposed by any relationship to the interest of navigation.

100. The board in prior reports, printed in House Documents No. 246, Sixty-third Congress, first session, and No. 914, Sixty-third Congress, second session, endeavored to point out the practical impossibility of a proper control of streams for the purpose of flood protection when the dividing line between control by the United States by reason of relationship to the interest of navigation and control by the several States by reason of their sovereignty is incapable of exact

or even approximate determination. It there stated (par. 16, Doc. 246):

> The board has been much impressed in its examination by the evils of divided control of the watercourses. The obstructions which have been placed along the various streams ought never to have been put there, and their construction should have been prevented; but since the control of rivers is in the twilight zone between the spheres of Federal and State authority it developed that what was anybody's business was nobody's business, and no effective authority has been exercised by anybody. These rivers are feeders of a navigable stream and have an important effect upon the regimen of the Ohio River, and it is the opinion of the board that the authority of the United States should be exercised to prevent encroachment upon them exactly as in the case of navigable streams. It is believed that this is the only method of control which promises good results in practice. The board further urges that immediate steps be taken to exercise such authority, since bridges and other structures are to be rebuilt at once, and there is evident danger in several places that they may be rebuilt in an obstructive manner.

101. Control over our waterways for purposes of flood prevention and protection must, in the opinion of the board, be delegated to one central authority before any rational plan for flood control can be devised, and compliance with such plan, or other measures for the amelioration of flood conditions properly enforced. This central authority is logically and necessarily the Federal Government.

102. The board wishes to emphasize its opinion, however, that such control should preferably not be based on the uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that will accrue in the protection of life and property from loss and the interruption by floods of general interstate commerce and the interference with the mails.

103. No method of flood protection, even for a single locality, should ever be adopted without a study of the effect of the proposed plan upon flood heights in the stream both above and below the point where the contemplated changes are to be made. For it is certain that a plan considering only the local effect will have the result of increasing flood heights at other points. If the plan contemplates holding back the water at a certain point, the result can be secured only by damming it back at that point with consequent increase of height at localities higher up. If it provides for an enlarged channel or otherwise for an increased rate of flow past the point the result will be the pouring of more water into the lower stream in a given time than it would otherwise have received and a flooding of localities which would have escaped. No method changing the conditions at one point can be adopted without changing the conditions at other points, and care must be taken that while the beneficial effect is secured at the first locality the results at the other localities affected are not unreasonably detrimental.

104. No method should be adopted without careful consideration and an accurate comparison between the value of the protection afforded, on the one hand, and the cost of the changes themselves, combined with the damages to other localities, on the other. A reservoir might be used to protect a community and the cost of the creating dam be reasonable, but the value of the land taken for the reservoir might make the cost of the remedy out of proportion to the damage which it is intended to prevent. The building of levees may secure a community from high waters, but the increased flood heights at other points will involve the building of new levees

or the giving of additional height and strength to old levees at other places, unless the damage is to be merely transferred from one locality to another. The cost of these new levees and of the additions to the old ones thus becomes an item of the cost of protection which should receive consideration. Too often the plan of floor protection adopted by one community is that selected solely for its relatively small cost and without the cooperation of or consideration for other parts of the river.

105. A dam either for impounding the water or restraining the flow can not be utilized without flooding a tract above it, depending in area upon the height of the dam and the slope of ground. In very hilly or mountainous districts, as upon the tributaries of the Monongahela, the valleys will be deep and the reservoirs narrow and long, while the value of the land for agricultural purposes will probably be small per acre, although where there are coal mines or coal deposits the mineral value of the land may be large. Where the land is only moderately hilly or rolling the dam will be low in height, but the reservoirs will be much larger in area and shallower for a given capacity than in a mountainous region; the land will also probably be of higher value per acre, so that its cost will be high, if not excessive. It must also be remembered that the damage from floods is only occasional, in some instances even rare, but that the withdrawal of land for an impounding reservoir is immediate, continuous, and perpetual, while for a restraining reservoir its use is so modified and uncertain that its present and future value will be greatly impaired. Thus a reservoir cost which is in itself smaller than the money value of the protection it affords may by its interest charges amount to much the larger sum in the course of a few years.

106. Most streams have low-lying lands along their courses which are overflowed by the stream as soon as it rises beyond its banks. These lands, technically termed "the flood plain," form a natural reservoir of greater or less capacity, depending upon their extent and the depth to which submerged.

107. Levees decrease the natural reservoir capacity of the stream. Where a flood overspreads the natural lowlands along a river the current across these overflowed lands is usually gentle compared with that in the stream channel, unless some artificial obstruction, such as road embankments or fills for other purposes, so contracts the waterway at some point as to cause a backing up of the water there. An overflow without strong current is seldom harmful to the land and is not ordinarily objectionable unless it enters buildings or occurs when crops are in the ground. On the Ohio and its tributaries floods have usually occurred too early in the season to interfere materially with crops, while along the lower Mississippi, owing to the earlier season in the more southern latitude and to the later arrival of the flood waters at this part of their course, the overflows are apt to damage or destroy the season's crop. Levees, by diminishing the natural reservoir capacity of the stream, throw the waters into the lower river more quickly and to a greater height than would otherwise occur. Levees of insufficient height or without proper channel capacity between them are liable to fail or be overtopped in excessive floods, with the resulting damage to large areas of the land that they were intended to protect, for the suddenly loosed waters either wash away the topsoil or cover it with a coat of sand and gravel. A levee

built by a community for the protection of one side of a river only is rarely placed with any regard to the width of waterway requisite to carry the flood flow or to the interests of the property owners on the opposite bank unless the location is supervised by some competent authority. The board knows of one case where a drainage district recently built a levee along the banks of a river and so close to the stream that had the people on the opposite side built one similarly situated the area of the channel left between the two levees would have had a capacity sufficient for only one-fifth of the water carried in freshets occurring every few years. There is no method of flood protection requiring more intelligent supervision than the proper establishment of levees, and there is none for which one authority having jurisdiction throughout the length of the stream is so greatly needed to secure safe results, not only to protect one community against another, but at times to keep a community from damaging itself, for an improperly placed or poorly built levee is certain to do one or both. The same remarks apply also to a great extent to such local channel improvements as are discussed in this report.

108. In those States which have a regularly organized commission or other body legally empowered to supervise plans for flood protection and to veto improper projects or ill-considered plans, something can be done to prevent one community from injuring another, but in many States the people on one portion of a river have but little or no redress against the work detrimental to them which may be undertaken by the people upon another portion. Even where such a commission exists it is in many respects powerless to prevent constructions which are recognized as inadvisable and known to be dangerous. An instance which was recently brought to the attention of this board was that the commissioners of a county building a bridge across a stream within the limits of a certain city. For economical reasons the bridge was made as short as possible, and did not provide sufficient space underneath for the heavier floods to which the stream is subject. The city endeavored to prevent the building of the bridge and attempted to secure the adoption of some other plan which would not interfere with the high-water flow, but was unsuccessful. The stream was not one regarded as ordinarily navigable, and appeal could not be made to the War Department. It is doubtful if any authority exists in most States to prescribe the amount of opening which must be left for the passage of flood waters at any bridge or in a railroad or highway embankment across the bottom lands adjacent to a river, or to prescribe the height of such embankment, provided the proper openings are not made. Only Congress can exercise controlling authority where the questions arise between parts of a stream in different States.

109. It is probable that the Federal Government may exercise control over conditions affecting floods in streams upon other grounds than the resulting influence upon navigation, although Congress has as yet not seen fit to exercise such control of nonnavigable rivers upon these other grounds. The flood of 1913 throughout the States of Ohio, Indiana, and Illinois interfered with the carrying of the mails and with commerce between the States. The damage which this flood caused would have been lessened and the interruption of commerce and of the transmission of the mails would have been less serious and of shorter duration had there been some supervision and

control of the ambankments and fills which had been made at will in the flood plains of the streams and of the encroachments which had been made upon the stream channels. The same results occur in other floods and upon other rivers throughout the country, and as long as there is no authority to supervise constructions along the stream and none to enforce a reasonable regulation, the interruptions of commerce and mail carriage, as well as damage to property and loss of life, will continue. That an excessive erosion upon a tributary which is not navigable will eventually produce conditions in the main stream which is navigable is probable, but the result is remote, and depends upon so many contingencies of irregular occurrence that the connection between any particular encroachment or inadequate construction and a shoaling in the main stream is too remote to permit an enforcement of proper conditions upon the theory of effect upon navigation alone.

110. The board has already expressed its opinion that, basing action on the benefit to navigation alone, the United States is not warranted in cooperating with the States and other communities and interests in devising and carrying out plans for flood protection on the Maumee River, but it does believe that there should be some competent authority established to exercise control over work along all streams for the purpose of controlling or preventing floods, so as to prevent or diminish the interference with mail communication and commerce. Congress has recently recognized the importance of this subject by creating a new committee upon flood protection, and this board recommends that the authority of the War Department, which now exists upon navigable waters, be extended so as to give it supervision over all structures and constructions hereafter placed upon nonnavigable streams which may unduly interfere with stream flow and increase flood heights and flood damages and interfere with interstate commerce.

LANSING H. BEACH,
Colonel, Corps of Engineers.

[For report of the Board of Engineers for Rivers and Harbors, see p. 6.]

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